ELECTRICAL ENGINEERING

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ELECTRICAL ENGINEERING

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The Cover. Portable units used by the United States Army Air Forces for testing air-borne radar sets. The use of microwave testing equipment is described in a paper in the *Transactions* section of this issue (*pages 274–90*).

Photo courtesy Radiation Laboratory, Massachusetts Inst[illegible]ute of Technology

TRANSACTIONS SECTION

(Follows EE page 244; a preprint of pages 241–320 of the 1946 volume. Any discussion of these papers will appear in the June 1946 "Supplement to Electrical Engineering—Transactions Section" and in the 1946 volume.)

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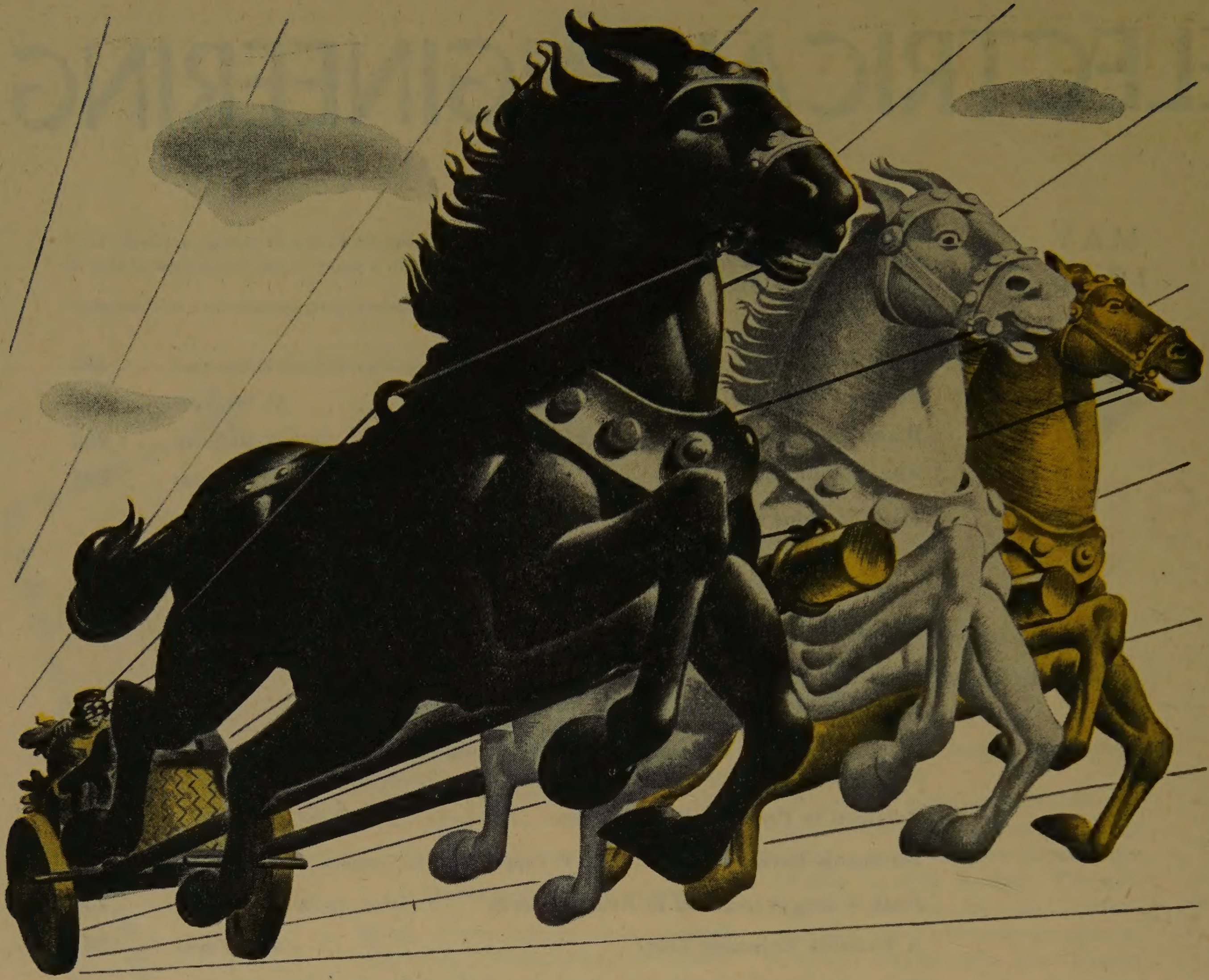

HIGHLIGHTS........

Summer Convention. Advance plans for the summer convention to be held in Detroit have expanded to prewar dimensions. Electronics and instruments and measurements have been given special importance in the program. Details of the four scheduled trips of a technical nature, the social events for men and women, the three golf tournaments, and the very necessary hotel accommodations already have been completed (*pages 214–16*).

Postwar Uses for War-Born Products. Many products which did valiant service for the Armed Forces during the war are now in a state of conversion to industrial form. The gyroscopic stabilizer, the absolute altimeter, and nuclear energy, among others, probably will be utilized to advantage in the postwar era (*pages 208–13*). One of the most important scientific developments to come out of the war, radar, contributed much to Allied superiority both in offensive and defensive warfare. In peacetime, radar can go far toward providing safety of navigation and traffic control on commercial air and sea lanes (*pages 202–07, Transactions pages 307–13*). One design suitable for peacetime application of radar is the "electronic navigator" (*Transactions pages 271–3*). For the testing of microwave radar, in general the same instruments and techniques are used as those involved in the testing of microwave radio communication systems (*Transactions pages 274–90*).

Mexican Electrification. The progress of Mexican electrification, which in the past had been slow due to the country's widely distributed agricultural population and extreme concentration of industry, was impeded further by wartime restrictions. The Mexican Government, in co-operation with privately owned public service companies, has taken stock of Mexico's electrical requirements and available power and on that basis has formulated a program to provide for the probable increase in demand during the next four years. Part I of a two-part article on the subject, prepared by members of the Mexico Section, appears in this issue (*pages 193–7*).

The Amplidyne. The amplidyne can be used as a voltage regulator, a speed regulator, or a current regulator, and can be applied to the control of a-c as well as d-c machines. Its high amplification powers and speed of response enhance its versatility (*pages 208–13*).

Engineering Organization. A conference at San Antonio, Tex., during the recent District meeting there, indicated a preponderance of opinion favoring "Plan B" of the planning and co-ordination committee's progress report (*EE, Apr '46, pp 169–73*) looking toward collaboration with the National Society of Professional Engineers on so-called "professional" matters and toward increased activity within the Institute on technical matters (*pages 217–18*).

Standards. A summary is given of a "Proposed Standards for Pool-Cathode Mercury-Arc Power Converters," which has been prepared as a revision of the 1934 AIEE "Report on Standards for Acceptance Tests for Metal-Tank Mercury-Arc Rectifiers" (*pages 224–5*). A comprehensive review of the revised "American Standard for Automatic Station Control, Supervisory, and Telemetering Equipment," also appears in this issue (*pages 223–4*).

Research Legislation. The McMahon Bill (atomic energy) and the Kilgore–Magnuson bills remain in the news. The presidents of four engineering societies have telegraphed their approval of the inclusion of a division of engineering among the civilian advisers in the McMahon control scheme (*page 235*), and the second bill has provoked an adverse statement of policy from the National Association of Manufacturers (*pages 235–6*).

Arcing Ground Tests. Contrary to current theory that arcing grounds of the restriking type can cause voltages to ground on an ungrounded system of the order of 6 to 8 times normal, investigation has proved that these voltages under ordinary circumstances are not likely to be greater than 2 to 3 times normal. One thus may conclude that deteriorated bus insulation rather than very high voltages is responsible for multiple insulation failures (*Transactions pages 298–306*).

NEWS 214

Pilot Wires. A method of protection has been devised for pilot wire systems which provides reliable and satisfactory operation of a-c pilot channels through low-voltage telephone-type cable, even though induced potentials high enough to operate discharge gaps may be present. This new method obviates the necessity of heavy over-insulation for protection in cases where conventional methods are not suitable (*Transactions pages 267–70*).

Rejection Filter. A new device which will remove leak and stray pilot frequencies from carrier telegraph systems with little disturbance to other parts of the system employs a Wheatstone bridge circuit whose capacitor elements may be adjusted to reject any frequency in a range of two to one. Two sections in tandem are used to secure a greater width of rejection band (*Transactions pages 263–7*).

The Betatron in Industry. Under supervision of the Office of Scientific Research and Development, the betatron was developed from a physics laboratory apparatus to an industrial radiographic machine. Betatrons having a maximum energy of 20,000,000 electron volts have proved their value to industry by detecting small flaws in as much as 20 inches of steel or other heavy metal (*Transactions pages 241–6*).

Model Law. With the recent action of the AIEE board of directors officially recognizing the "Model Law for the Registration of Engineers", the subject is of renewed importance to Institute members. Full text of the latest (1945) revised edition is reprinted here *pages* (*219–21*).

Letters to the Editor. Walther Richter (F '42) and K. L. Hansen (F '34) continue a friendly dispute over "the concept of generating a voltage by the cutting of magnetic lines" versus "the concept of having the voltage generated by a change of flux associated with a loop" (*pages 242–4*). C. M. Jansky (F '32) reminds readers of *Electrical Engineering* that the recent radar-to-the-moon tests made by the Signal Corps were not the first demonstrations of atmospheric penetration by electromagnetic waves (*page 244*).

Miscellany. Numerous reports have appeared in the press outside the United States of revived activity in the electrification of railroads (*page 237*) and in hydroelectric undertakings (*page 236*). Research Corporation, New York, names the projects and institutions it will aid for the coming year (*pages 238–9*). Announcement of an award for engineering educators raises the question of what standards will guide the choice of a recipient (*page 242*). Reconversion reaches the Big Inch pipe line, as application is made to use it for transporting natural gas instead of oil (*page 240*).

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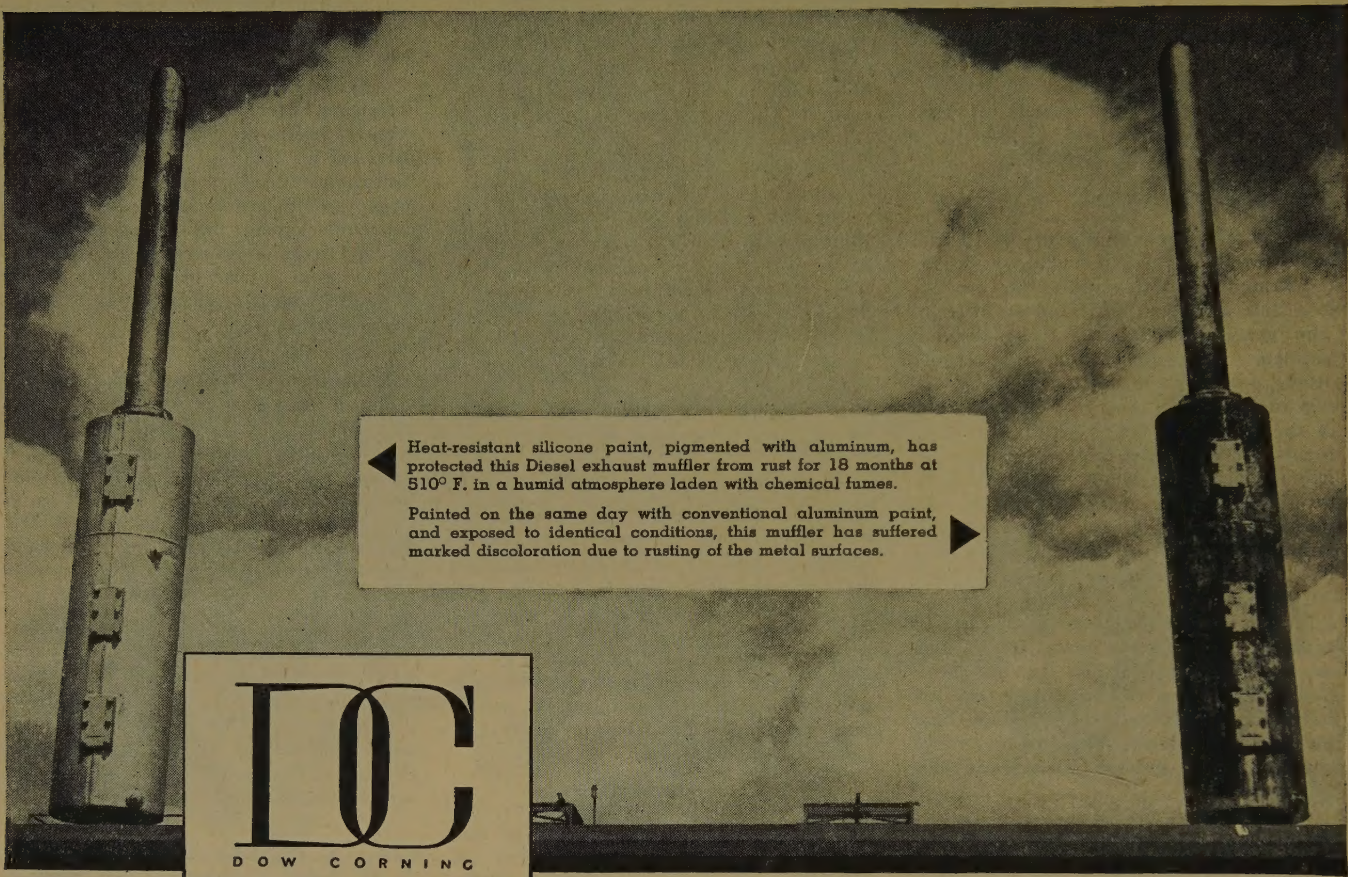

Heat-resistant silicone paint, pigmented with aluminum, has protected this Diesel exhaust muffler from rust for 18 months at 510° F. in a humid atmosphere laden with chemical fumes.

Painted on the same day with conventional aluminum paint, and exposed to identical conditions, this muffler has suffered marked discoloration due to rusting of the metal surfaces.

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Mexico's Electrification Program— I

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This first part of a two-part article presents a general picture of what has been accomplished thus far in Mexico's effort to solve its power problem as the first step toward industrialization. Part I concentrates on the present status of the Mexican electrical industry and the reasons for its belated development. It includes a discussion of plans for the future which call for an increase during the next four years of 53 per cent over the capacity of existing installations.

THE PURPOSE of this article is to acquaint the reader with the present status of electrification in the Mexican Republic. It may appear that the results already obtained and the plans proposed for electrification are very modest, when compared with accomplishments and results achieved in the United States, but they are of vital importance to the economy and welfare of Mexico.

The development of the electrical industry in Mexico in the past has been very slow. This is explained by many causes. The principal reason which, during the past year, prevented the electrical as well as the industrial development of the country, was the restricted possibility of obtaining machinery and equipment required for increasing the productivity of the industries as well as for increasing the capacity of the electrical plants and of the transmission and distribution systems. This resulted in a general slowdown of such developments during the years of emergency, in spite of the country's requirements.

With the end of the war and better prospects for obtaining machinery and equipment, a large number of Mexican industries are anxious to obtain additional power for enlarging their existing works as well as for establishing new factories. Taking as a basis the immediate requirements of various industries for additional power as well as the most pressing needs of the rest of the population, the figures given in this article should be considered as a minimum of work to be accomplished during the next three to four years.

For a better illustration of present conditions and of the problem ahead, a number of figures are presented which give a comparison of statistical data in the United States and Mexico pertaining to the electrical industry. It is hoped that familiarity with these data will inspire an appreciation of the work which must be accomplished and the difficulties which must be overcome under the existing economic possibilities in order for the great mass of population to receive the benefits of electricity.

Essential substance of a paper presented by the Mexico Section at the AIEE South West District meeting, San Antonio, Tex., April 16–18, 1946. Paper was prepared under direction of Basil Nikiforoff.

Basil Nikiforoff is chief electrical engineer and **Alfonso Fernandez del Busto** is assistant superintendent of transmission and distribution, both of the Mexican Light and Power Company, Limited, Mexico, Federal District, Mexico. **Alejandro Paez Urquidi** is head of the rate and cost department, Cia. Impulsora de Empresas Electricas, Mexico, and **Oscar R. Enriquez** is head of the hydroelectric division, Comision Nacional de Irrigacion, Mexico.

THE PROBLEM OF ELECTRIFICATION AS AFFECTED BY THE CHARACTERISTICS OF THE COUNTRY

In order to explain the reason for the actual state of the electrical industry in Mexico, as well as its most pressing requirements, it is necessary to outline briefly the main characteristics of the country which affeet the electrification problem.

Mexico occupies an area of 758,259 square miles. Its population, according to the 1940 census, is 19,654,000, an average of 26 people per square mile while the average population per square mile in the United States is 44 persons. The density of population in Mexico is not only very low but also the major portion of the population lives outside of the large centers and in small townships with less than 1,500 people per town (see Table I).

Table I. Distribution of Population in Mexico

Size of Cities (Number of Inhabitants)	Accumulated Sums: Number of Cities	Accumulated Sums: Population	Percentage of Total Population	Corresponding Percentage in the United States
More than 100,000	4	2,001,581	10.2	28.8
More than 50,000	13	2,652,970	13.5	34.4
More than 20,000	43	3,551,094	18.1	
More than 10,000	97	4,296,265	21.8	47.6
More than 5,000	262	5,397,544	27.5	52.7
More than 2,000	966	7,469,227	38.0	
More than 1,500	1,491	8,369,075	42.6	
Total number of localities	114,945			

As Table I shows, more than 50 per cent of the population in the United States is concentrated in

cities of 5,000 or more inhabitants while in Mexico this figure is only 27.5 per cent. Even including the centers of population with only 1,500 inhabitants or more this figure will be only 42.6 per cent.

The situation is reversed in a comparison of the distribution of industries throughout Mexico. These are concentrated largely in a few states. Estimating the concentration of industries on the basis of the value of their production will give the following results:

Federal District	31.4 per cent
Nuevo León	11.8 per cent
Puebla	10.4 per cent
Veracruz	9.8 per cent
28 remaining states	36.6 per cent

Actually the concentration of industries is even greater as they are not distributed throughout the few states mentioned but are concentrated in one or two zones of each state.

As a result of such industrial concentration, electrical service systems have been developed mainly to supply the industries or, in a few cases, agricultural centers, omitting large extensions for scarcely populated parts of the country where there is little demand for energy.

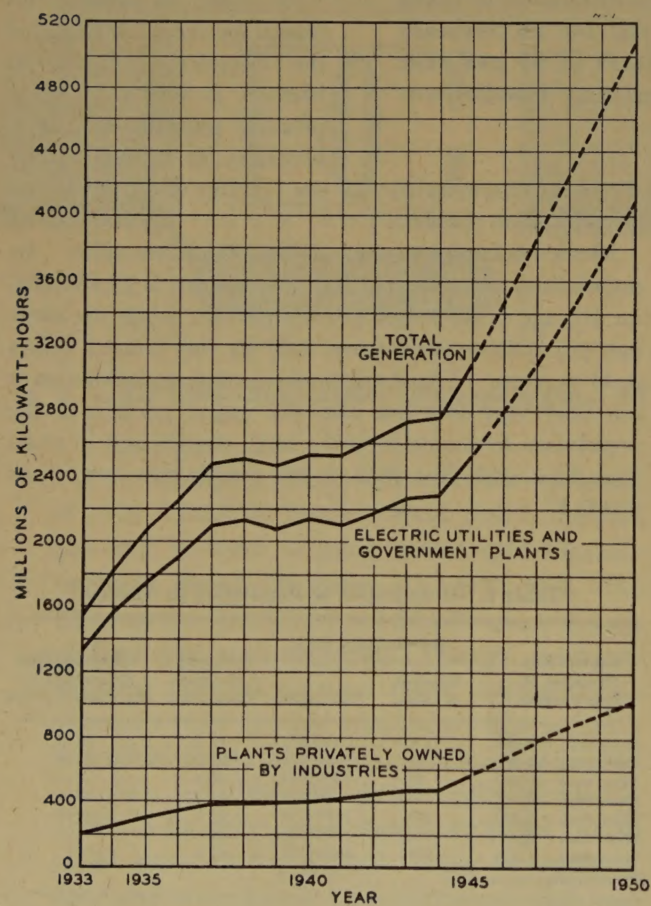

Figure 1. Representation of total annual power generation in Mexico since 1933, including probable generation for the years 1946–50

The difficulty of supplying power economically from large electrical systems to scarcely populated regions, with people having small purchasing power and a low standard of living, has been overcome partly by the installation of a large number of small isolated plants supplying individual localities, but even this solution provides electrical service for only 1,206 townships out of a total number of 114,945 localities. Therefore, counting the centers of population with less than 1,500 inhabitants only, approximately 1.1 per cent of such localities have electrical service at present. In the country as a whole approximately 4,000,000 people, or only 20 per cent of the total population, use electricity, leaving approximately 16,000,000 people without this facility. The lack of electrical supply throughout the country is also the reason why new industries are being located close to the already existing industrial centers in preference to location in the country near the source of supply of raw materials, thus aggravating the situation.

Mexico's electrification problem has two principal aspects:

1. To have available sufficient generating capacity for satisfying the needs of the population and industries and permitting their unhampered development instead of limiting the use of electricity, as at present, to the amount of energy available.

2. To promote and develop new industrial and agricultural centers, providing them with an abundant supply of power from new generating plants to be created for that purpose and from transmission and distribution networks of the existing power systems.

PRESENT STATUS OF THE MEXICAN ELECTRICAL INDUSTRY

A total of 1,266 generating plants were in operation at the end of 1945 with a total capacity of 756,000 kw, and a yearly production of 3,068,000,000 kilowatt-hours. While the average capacity of all of these plants is only 600 kw, the capacity of the largest hydroelectric station at Necaxa reaches 100,000 kw. Of the total number of plants, 623 belong to public service utilities, the balance being industrial plants, although some of these sell part of their production to the public. Approximately 58 per cent of all of the plants use hydraulic energy. The rest are divided equally between thermoelectric and internal combustion type. Approximately 56 per cent of the total capacity is generated at a frequency of 60 cycles, 42 per cent at 50 cycles, and the remaining 2 per cent at 42 and 25 cycles or direct current.

From the foregoing figures it can be seen that the installed generating capacity per capita equals 38 watts with an annual consumption of 156 kilowatt-hours, or 1/10 and 1/11 respectively of the figures corresponding to the installed capacity and consumption per capita in the United States. The curves in Figure 1 indicate the total annual generation of the country for the years 1933 to 1945 as well as the probable annual production of electric energy from 1946 to 1950. The curve per-

mits analysis of the conditions under which the development of the electrical industry took place during the last 12 years.

Between the years of 1933 and 1937 the average annual growth of production was 12.8 per cent, varying from 8.8 per cent as the minimum in 1936 to 20 per cent as the maximum in 1934. This growth may be considered as representing the normal development of the industry, but could be qualified as too low, considering that it coincided with the beginning of the establishment of manufacturing industries in the country. The normal increase of production was slowed down between 1937 and 1944, because of various economic reasons and the internal condition of the country. This also affected the development of other industries. By 1938 practically all public service companies found themselves overloaded and without any reserve capacity.

In 1938 Mexico passed through an abnormally dry year which contributed to the seriousness of the situation of the electrical industry and, as the major portion of power is provided by hydroelectric plants, the resultant scarcity of energy forced the supply companies to restrict the consumption of their customers and to suspend the contracting of new services. Dry years were repeated twice in the period of 1938–1944, thus requiring restrictions on electric energy in 1940 and 1941 and in 1943 and 1944. This period also coincided with the World War II which left Mexico lacking many essential industries and in a condition of severe shortage of power. This again handicapped the increase in industrial production at a time of its maximum need.

Mexico obtained full co-operation and understanding from the United States during the war and was able to obtain permits and priorities for the manufacture of new generating equipment in the United States for existing and new generating plants as well as for other equipment necessary for transmission and distribution of energy. Unfortunately, the heavy burden imposed on American industry by the war necessarily delayed the supply of such equipment and only in 1944 was it possible to increase the generating capacity of the country by the installation of several large new units which partly relieved the power shortage.

A similar effect also could be observed in other industries which found themselves in the unfortunate position of being unable to increase their productive capacity during the war. They could obtain new machinery and equipment only at the end of 1944 and the beginning of 1945, when there was a considerable increase in demand for electrical services.

All this contributed to the reason why, for a period of seven years (1938 to 1944), the total increase of power production reached a figure of only 8.7 per cent, based on the 1937 generation, a figure which is lower than the minimum yearly increase in normal years.

In the year 1945 a considerable improvement in the situation could be noticed, the yearly increase in the generation being 11.5 per cent as compared with that of 1944. In the same year the annual average load factor for Mexico increased to approximately 50 per cent, indicating better utilization of available capacity. It could be increased still further if the load factor could be brought up to 60 per cent by displacing some of the loads from the hours of peak demand or by filling in the valleys.

There are, however, the limitations imposed by the hydraulic resources of the present system, which, as already mentioned, add up to 58 per cent of the total installed capacity in the country. Experience has shown that, in the majority of cases, the present systems cannot increase their output in kilowatt-hours except in very rainy years. Any increase in production has to be provided for by new hydroelectric or thermoelectric plants that can be used as peaking plants as well as for compensating for the shortage of water in dry years, thus permitting a better utilization of the hydraulic resources.

At present, in spite of the fact that substantial generating capacity was added at the end of 1944 and during the past year, the condition of the electrical industry remains critical. It still lacks the necessary capacity for satisfying, during the next three to four years, the demands of the growing industry of Mexico, as well as some indispensable reserve capacity at the plants. Restrictions on the use of power had to be imposed in 1945 as well as this year in some sections of the country.

Figure 2 illustrates the principal electrical supply systems and their relative locations, as well as the location of isolated plants of over 1,000-kw capacity serving some of the industrial centers of the country. No attempt was made to indicate the location of plants smaller than 1,000 kw each, which, along with others, make up a total of 1,266.

PROBABLE INCREASE IN LOAD AND PROPOSED CONSTRUCTION OF NEW GENERATING PLANTS

Studies made by the Mexican Government, through the Federal Commission of Electricity and public service operating companies, which are based on actual requests for power by various industries as well as on estimations of probable increases due to normal growth indicate that the following production of power will be required in the next four years in order to be able to satisfy the probable demand:

Year	Production (Million Kilowatt-Hours)	Per Cent Increase
1945	3,068	
1946	3,460	12.8
1947	3,840	11.0
1948	4,240	10.4
1949	4,660	9.9

Based on 1945 production the tabulation shows an increase of 52 per cent for the four year period, 1946–1949. It seems necessary, therefore, in order to satisfy

Figure 2. Location of principal electrical supply systems and of isolated plants over 1,000-kw capacity

Number	Name	Total Capacity (kw)	Generation in 1944
1	Laguna Chihuahua interconnected system	70,320	273,000,000
2, 6, 14	Chapala system and affiliated companies	29,087 (Chapala only)	141,000,000 (Chapala only)
3	Interconnected system of Guanajuato	28,860	164,000,000
4, 5, 7, 10, 11, 12, 13	Electric systems of Comision Federal de Electridad	28,000 (One unit Ixtapantongo project)	63,000,000 (Four months Ixtapantongo project)
8	Mexican Light and Power System	266,610	1,071,000,000
9	Puebla interconnected system	46,533	183,000,000

the probable demand and to have the necessary reserve capacity, to increase the installed generating capacity and the production of energy over 52 per cent of the existing capacity and production of Mexico.

A program was formulated by the Mexican Government through the Federal Commission of Electricity in co-operation with privately owned public service companies for increasing the generating capacity throughout Mexico. This program includes plans for the installation of new power plants and extensions and amplification of the existing plants to the extent of 400,000 kw during the next four years, or an increase of 53 per cent over the capacity of the existing installations.

It is proposed to install during 1946 and the first part of 1947 a total of 180,000 kw of additional generating capacity for which most of the equipment and machinery has been purchased in the United States. Some of this equipment now is being installed and will be ready for service by the end of this year or at the beginning of the next. Among this equipment is a hydroelectric unit of 39,000 horsepower with a head of 1,040 feet and a 25,000-kw steam turbine unit. The remaining 220,000 kw will be installed in the period from 1947–1949. Part of this equipment also has been purchased in the United States and preliminary installation work is already under way.

The establishment of new plants and an increase in

the generating capacity of existing installations naturally also will require extension and amplification of transmission and distribution systems. It is estimated that the cost of the proposed work for the next four years will be close to 500,000,000 pesos (approximately $100,000,000). The major portion of this sum is to be spent during the present and coming year.

Suppose that by 1949 the population of Mexico reaches 23 million people. The installed capacity per capita then will be 50 watts with a yearly generation of 203 kilowatt-hours per inhabitant, figures still very much inferior to those of the United States. The plans for the electrification of the country probably will have to be revised and amplified by the end of 1949, as there is a definite tendency toward raising the standard of living of the rural element which forms the major portion of Mexican population.

Preliminary studies are being conducted by the Mexican Government and public service companies for further utilization of the natural resources, principally hydraulic, in order to increase the capacity and production of electric energy in preparation for future demands. The natural resources which can be utilized for these purposes are, comparatively speaking, easily accessible and undoubtedly will be of prime importance in the future development of the country. Part II of this article, which will appear in a subsequent issue of *Electrical Engineering*, discusses the possibility of using the hydraulic resources of Mexico as well as those of the oil and coal industries.

Postwar Engineering Developments

M. W. SMITH
FELLOW AIEE

Many products of wartime research and development will find a productive place in the postwar world. Some of these, such as radar, the gyroscopic stabilizer, and various new materials already are in the evolutionary stage with definite applications in sight; the potentialities of others, including the most sensational development, nuclear energy, are being explored actively.

During the war years much was said and even more implied about the marvelous things being done in research laboratories and engineering organizations that would have vast and almost revolutionary peacetime uses. Now the question is, "Will these predictions be realized?"

Like the answers to most engineering questions this one, too, is equivocal, neither "yes" nor "no." However, undoubtedly enough of the predicted innovations will materialize to justify the pronouncements of the more realistic prophets but they cannot appear, full-grown, overnight. It should be remembered that many of these marvels of science were reported soon after the seed had been planted in the fields of war. The task now is to transplant them to the fields of peace and then to do a lot of back-breaking work in cultivating them, weeding them, and picking off the bugs before the products can be harvested. These things can be accomplished, but it will take time.

As an illustration of the many war-born developments that are being cultivated for peacetime use a few items may be mentioned that are at present in the transplanting stage.

During World War II the gyroscopic stabilizer did a remarkable job in holding steady the guns of a tank so that the gunner could fire with a high percentage of hits while the tank moved swiftly over rough ground. A modification of this device already has been applied to the stabilization of railroad passenger cars. Recent tests made over a wide range of speeds and varying conditions of roadbeds of the Pennsylvania Railroad show an improvement in riding comfort ranging from two to one to four to one, depending upon the degree of disturbing forces.

The next installation of the ride stabilizer will include a supplementary device to tilt the car body to the proper angle in order to balance the effect of centrifugal force on curves regardless of the superelevation of the track. It is actuated by a pendulous control using a small gyroscope for anti-hunting which recently was built and

Essential substance of an address presented at the AIEE South West District meeting, San Antonio, Tex., April 16–18, 1946.

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tested at the research laboratories of the Westinghouse Electric Corporation.

For the United States Army Air Forces an instrument was developed with a dial which indicates the absolute distance an airplane is above the ground, instead of its height above sea level. This instrument, which obtains its indications from a radar set, can provide absolute altitude above obstacles within five feet. Such a device

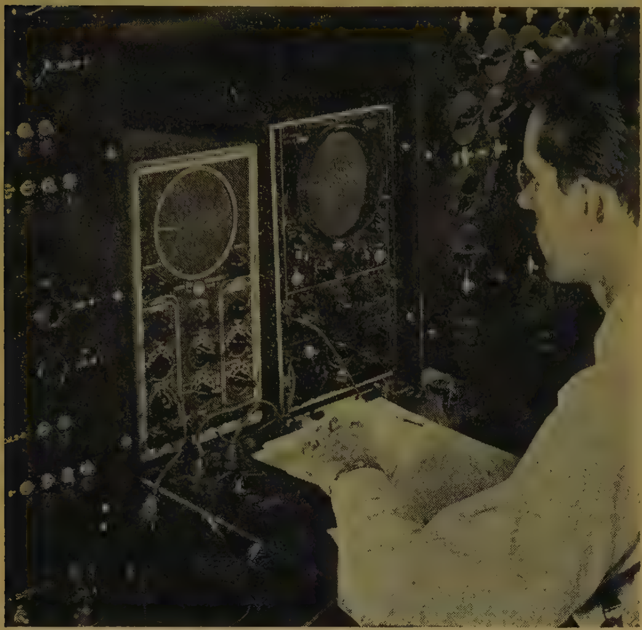


Figure 1. Transient analyzer presents solution to problem through wave patterns on a fluorescent screen

Wave pattern on right screen shows oscillations in current that occur when a short circuit "hits" a generator while that at left indicates resultant mechanical stresses in generator shaft. Results are being studied by G. D. McCann (M '44)

obviously is a great boon to safety of flight in mountain regions, and during storms and darkness. The absolute altimeter, or some form of it, probably will be adaptable to commercial airplanes.

Radar, of course, will have other peacetime applications. For example, on a recent trip of the vessel, the *City of Richmond*, from Baltimore, Md., to Norfolk, Va., the pilot had before him on a fluorescent screen a map which showed the passing shore line, every obstacle, every buoy—even every rowboat. The principle employed was navigational radar, a direct descendent of military radar. Radar also may be employed for such uses as air traffic control, airplane fog beacons, television relaying, and railway signal communications.

As an offshoot of radar research an entirely new concept of television broadcasting, "Stratovision," has been introduced. In this system the television transmitters will be carried by airplanes cruising six miles above the ground. Programs originating in ground studios will be beamed to the airplanes, then rebroadcast to television receivers in homes. Because television waves, like radar waves, travel in a straight line and do not follow the curvature of the earth, the high elevation of 30,000 feet from which the television signals will be broadcast will increase the range from which the signals may be received satisfactorily from approximately 25 miles to more than 200 miles, and with much smaller capacity transmitters on the airplanes than now are required at the land sending stations.

Because of its novelty and the spectacular part it played in many phases of the war, the term "electronics" often has been overrated and misused by many writers bent on arousing the public's imagination and fancy. Nevertheless, it did play a very important role during the war in many broad fields outside the ultrahigh-frequency field of radar previously mentioned. Its peacetime uses will be just as important. Its possibilities in the field of inductive and dielectric heating alone are too many and too varied to enumerate.

Examples of other items that might be mentioned are the application of electronic excitation systems to large high-speed generators such as the 80,000-kva unit at the Springdale plant of the West Penn Power Company, and a magnetic torque meter for indicating airplane engine output under load by utilizing the principle of the magnetic strain gauge to measure shaft twist.

In considering new products, the importance of materials must not be overlooked. It is often necessary to develop new materials such as special alloys, resins, and plastics to surmount limitations encountered in the course of apparatus developments. One family of high-temperature alloys has strength, ductility, and creep characteristics over a temperature range of 1,200 to 1,500 degrees for different applications. Alloys of this type were employed in the development of gas turbines and jet-propelled engines, and are still one major limiting factor in their future progress.

New materials, such as silicones and "Fosterites," also have been developed in the plastic field. The silicones are high-temperature insulation compounds developed by the Dow-Corning Corporation, which in conjunction with high-temperature materials such as mica and glass, show promise of reducing materially the size and extending the life of electric equipment. The Fosterites (Westinghouse) were used to moisture-proof radar equipment during the war.

Anticipating a step toward substantially higher transmission voltages, an experimental program designed to obtain information for this purpose has been launched through the co-operation of a large power company with several equipment manufacturers. The art of transmission-line design has progressed to the point where practically lightningproof performance is an accepted accomplishment for voltages from 132 to 220 kv and so, from lightning considerations alone, it would not be

necessary in designing a 345- or 460-kv line to increase the insulation or ground-wire spacings. It is certain, however, that corona losses would become prohibitive because even now they are a factor in the selection of conductor sizes and, therefore, because corona will be the controlling factor on higher voltage lines, it is essential to have accurate corona measurements under varying weather conditions.

The test facilities will consist of two $1^1/_2$ mile lines located just outside the Tidd station near Steubenville, Ohio, and arranged so that different conductors can be tested under identical weather conditions, for different seasons of the year, and over a voltage range of from 264 to 500 kv. The necessary equipment is being supplied by the co-operating manufacturers and the whole program is being co-ordinated by Philip Sporn (F '30), executive vice-president, American Gas and Electric Service Corporation. The tests are expected to get under way about the middle of 1946 and to continue for at least a year thereafter.

Increased activity is expected also in the distribution field on the basis of such trends as the extension of network-type of distribution to lower load density areas. Improved relaying schemes, together with banking of transformers, made practical by the introduction of a new type of distribution transformer will help this trend. With appearance becoming an increasingly important factor, particularly in suburban areas, the idea of eliminating the usual pole and aerial circuits by using trench-laid cable and semiburied transformers is another distribution item which is receiving favorable consideration by numerous utilities.

An impressive fact that often stands out in the course of research and development work is the knack of engineers to invent and fabricate the tools and equipment they find necessary for exploration of uncharted fields. An early and now familiar example is the network calculator, on which practically all conditions in power systems can be simulated by electrical constants on the calculating board and a reliable solution quickly obtained.

An important advancement along electrical calculation lines was evidenced recently by the development of the transient analyzer. This mechanical brain provides the means of solving a variety of problems through the use of electrical circuits in which combinations of inductances, capacities, and resistances can be connected in the proper relationships and proportions to represent faithfully the factors in the analogous problem to be solved.

While the realms of mechanics, thermodynamics, electricity, hydraulics, and other branches of science all are governed by their own set of provincial laws, fortunately there is such an orderliness in nature that the laws in one field are analogous to those in another. This fact makes it possible to solve many of the problems in allied fields by the use of the electrical analogue.

As a simple illustration of how the analyzer can be used, consider the problem of determining the short-circuit stress in the shaft connecting the rotating parts of a turbine generator. After calculating the actual values of the masses of the rotors, elastic properties of shaft, and damping characteristics of materials involved, these factors each can be represented in the circuit by proper proportions of inductance, capacity, and resistance respectively. To get at the solution of the problem, flashes of voltage corresponding to the amplitude and time variation of the short-circuit disturbance are applied repeatedly to this circuit by a set of rotating contacts. The resulting electrical waves taken from the appropriate part in the electrical circuit represent the solution to the problem. These electrical output waves are applied to a cathode-ray oscilloscope where they appear as a standing wave that can be photographed or studied. By varying the constants in the circuit until the most desirable condition or performance is indicated by the curve on the oscilloscope, it is possible to show in a relatively short time how improvements can be made in the original system. By changing the factors in the original design to correspond to the change indicated by the constants of the final setting on the calculator, the optimum design can be secured.

While this analyzer cannot produce answers with decimal-point precision, it does give engineering solutions to a variety of problems in a small fraction of the time that would be required by other types of calcu-

Figure 2. Jet aircraft engine shown in assembly cradle

Engine, which is so small that it can fit entirely within the wing of a fighter plane, reduces air resistance virtually to zero

lating means. The problems solved have varied from the simple illustration mentioned to the determination of the shocks to the grid in a vacuum tube when a crate of tubes is dropped. The time saving in complex cases runs into figures of days and months, and to ratios of 20 or 50 to 1 when compared to conventional calculation methods.

Figure 3. Radarscope on bridge of ship, *City of Richmond*, is studied by the captain (left)

Unit provides navigational aid and anticollision protection in any weather and in zero visibility within a distance of 100 yards to 32 miles from the ship

Mention was made earlier of the important bearing high temperature alloys had had upon the development of the gas turbine. Most of the progress made in this field during World War II has been on the jet-propelled engine, a special form of gas turbine developed for use on airplanes. The first jet engines already have been superseded by even more compact and powerful jet engines capable of producing thrusts equal to more than double their weight.

Military restrictions still prohibit the disclosure of the details of construction and performance of latest jet units but it can be said that their performance and reliability justify an optimistic prediction regarding the future use of both the jet engine and the geared gas turbine as important power drives on airplanes. Their light weight, small diameter, and reduced air resistance make them particularly suitable for this application.

Fundamentally, the gas turbine resembles the internal combustion engine in that in each one air is compressed, fuel is injected and burned, and finally high temperature gases under pressure are expanded to produce useful power in excess of that required to compress the air. Because the internal combustion engine uses one structure, a cylinder, for all three functions, its output must be interrupted cyclically whereas the gas turbine which uses separate mechanisms for each of the three functions produces a continuous smooth flow of power.

The normal efficiency of approximately 20 per cent for the simple open-cycle gas turbine at present-day temperatures is still considerably below the efficiency cycle of modern central station steam plants and so cannot be expected to compete as a source of base load power. However, it may find other applications in the power industry, perhaps sooner than is anticipated, for such purposes as peak load units located along existing backbone transmission lines. Perhaps it even may be practical in some instances to gear gas turbines to synchronous condensers and thus supply peak load power at distribution centers without the addition of any electrical generating capacity.

The transportation and marine fields seem to promise further opportunities for application of the gas turbine. A 2,000-horsepower experimental gas turbine has been built and is now on test. It is of the general type applicable to locomotives in combination with electric drives. Research work now being done in an effort to find practical and economical methods of burning powdered coal as a fuel looks promising and may materially accelerate and expand the application of gas turbines to locomotives.

Another interesting development which may have a marked influence on the progress of the open-cycle gas turbine is the free-piston gas generator. This is a form of gas turbine power plant in which the compressor, combuster, and that portion of the gas turbine used to drive the compressor are replaced by a Diesel-type cylinder in which combustion takes place. This cylinder has an extension in which there is a reciprocating free piston for compression of combustion and scavenging air. The high cycle efficiency of this type of plant, which is

well over 40 per cent, results from the fact that the top temperature of the combusted fuel is lowered by expanding it and using the extracted work to drive the compressor.

In any discussion of the commercial possibilities of the gas turbine, the closed cycle merits careful consideration. It provides means of getting around several restrictions which now limit the ultimate possibilities of the open cycle.

For example, it readily permits the use of coal as a fuel without any special preparation because the products of combustion are confined to the air heater and are not circulated through the turbines, compressor, and heat-exchange system. It should be noted, however, that the internally fired unit also has possibilities for such applications as propulsion for naval vessels and large passenger ships. Another important factor, particularly from the central station viewpoint, is that because of the opportunity afforded by the closed cycle to use higher internal pressures, the size of the gas turbine and air compressors can be reduced materially, thus permitting larger unit ratings approaching the limits of the steam cycle.

There seems to be little doubt about the practicability of building and operating a closed-cycle gas turbine. The 2,000-kw unit built and tested in 1939 by the Escher-Wyss Company, Zurich, Switzerland, operated quite satisfactorily from the standpoint of reliability and control, and developed an over-all thermal efficiency from fuel to generator terminals of more than 31 per cent at full load.

With the limited knowledge and operating experience now available, the big question mark seems to be one of economics and the determination of the practical balance between cost and performance. In an effort to get at this factor, a rather complete design and cost analysis of a 10,000-kw closed-cycle unit has been worked out. Cost estimates made on the most favorable assumptions justifiable on the basis of discussions with representatives of manufacturers of boilers and heat-exchanging equipment lead to the immediate but perhaps temporary conclusion that even the closed-cycle gas turbine unit cannot compete effectively with the present steam cycle. This unfavorable economic comparison results largely from the inherently high cost of the air heater and other heat-exchanging equipment.

European manufacturers have given a great deal of thought to the design of air heaters and have developed ideas which show promise of reducing the cost of such equipment to values appreciably lower than those now being considered. If these optimistic hopes can be realized, the closed-cycle gas turbine undoubtedly will find a place for itself in the central station field.

However, even though this goal is realized ultimately, it will come gradually through orderly processes of developmental evolution. Consequently, there is no reason for power companies to be concerned about the likelihood of the gas turbine creating rapid obsolescence in their power generating equipment. But, on the other hand, the gas turbine must be recognized as a potential future possibility that continually must be watched, supported, and evaluated.

When Einstein announced his theory of relativity and the specific relationship between mass and energy 40 or so years ago, it created little commotion outside a small scientific circle. Engineers took note of the statement but considered it to be of philosophical interest only, with no practical significance. This point of view prevailed not so much because there was general disagreement with Einstein's theory, but because few felt that it ever would be possible to find a practical way to release energy locked in the nucleus of the atom. Speculation as to this possibility gradually increased, taking a jump with the discovery of uranium fission in 1939, until a means of producing the chain reaction process was developed during the war, culminating in the atomic bomb demonstrations of 1945.

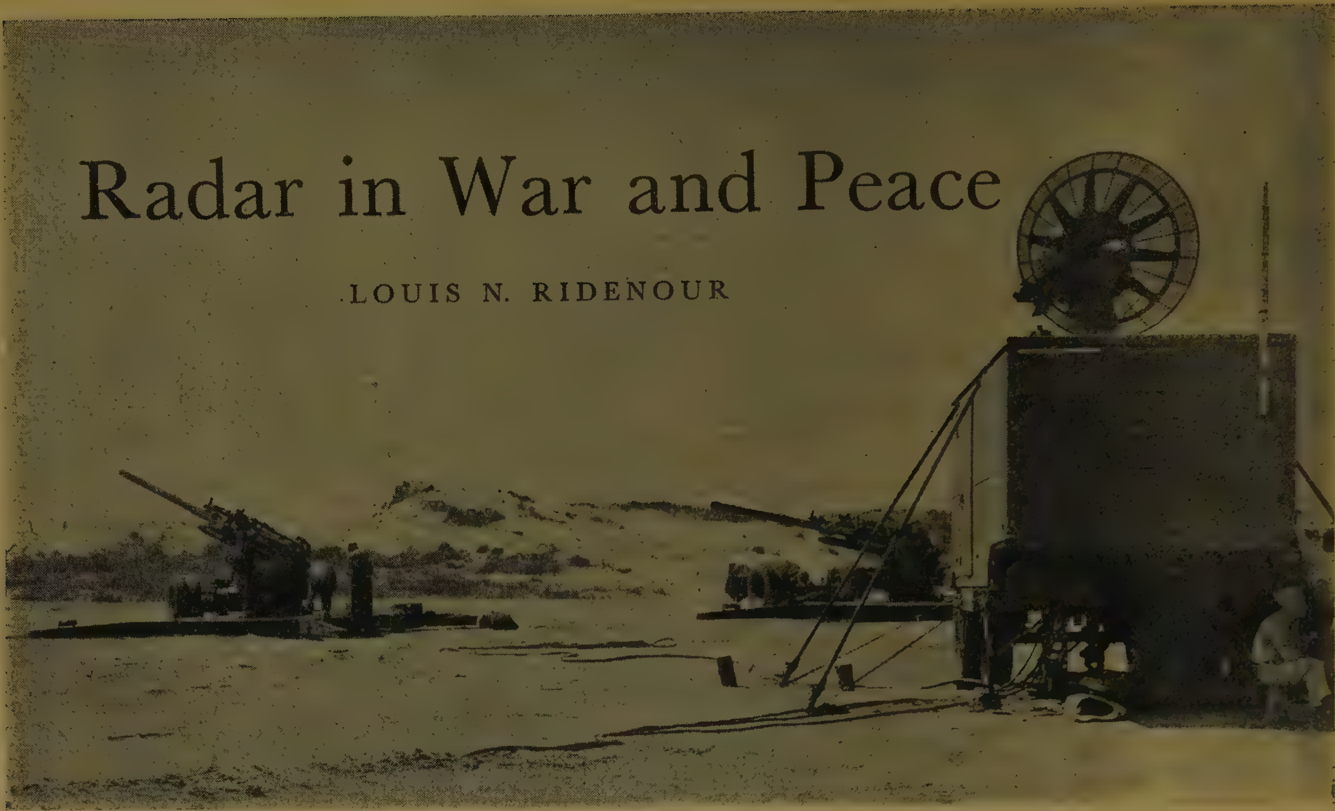
With the proof of the deadly destructiveness of atomic energy as a weapon before them, engineers now are directing their interest toward the prospects for constructive employment of this power. While research will continue on a large scale, development has been so rapid that, with its roots still in the laboratory, useful applications already are being sought in commercial fields. In recent issues of *Electrical Engineering* basic concepts of nuclear energy and the chronology of its development, as well as possibilities and economics of future applications, were discussed. There is little to add to those data at this time.

One big problem presented by the industrial application of atomic energy is the accomplishment of heat transfer at temperatures high enough to be applicable to modern high-efficiency heat engines. The appreciation of this fact already has led to some unsound proposals. However, we can be reasonably sure that somehow, some time, somebody will get a bright idea that, together with other steady evolutionary progress in this field, will make atomic energy a practical and economical source of power in commercial fields. Again, there is no apparent reason for power companies to fear rapid obsolescence from this source.

Here is another example of scientific progress that has great potential possibilities. Any basically new idea will have ramifications beyond our present comprehension and vision which will become apparent only with time and research. On the whole, progress still will be made in gradual evolutionary steps. However, it is certain that engineers and scientists will continue to make new discoveries; new ways to generate and utilize power, new ways to heal and save, even new ways to kill and destroy if necessary. What does this mean in terms of a better life? That will depend upon our world leaders and their success in devising a method which will insure a peaceful social, economical, and political future.

Radar in War and Peace

LOUIS N. RIDENOUR



The use of radar as a defensive warning signal and guide for antiaircraft fire as well as a control for offensive warfare was one of the chief advantages enjoyed by the Allies during World War II. In the postwar world, however, radar will have even more far-reaching effects as the most important element in the development of a completely safe navigation and traffic control system for both sea and air.

RADAR IS A COINED word compounded of the initial letters of "*ra*dio *d*etection *a*nd *r*anging." The phrase really should be "radio direction-finding and ranging," for the direction and range of a target are the two basic data which radar has to offer. Most of the radar equipment in present use is "pulse" radar in which the transmitter sends out a short burst, or pulse, of energy in the form of radio waves, and then is turned off long enough to permit the receiver to pick up the echoes of this pulse returned by radar targets in the neighborhood.

HOW RADAR WORKS

As the radio pulse travels to the target with the speed of light (186,000 miles per second) and the echo travels back to the radar set with this same speed, the time elapsing between the transmission of a pulse and the reception of an echo is a measure of the distance between the radar set and the echoing object. These times are very short, of course. An object one statute mile from the radar set will return an echo about ten millionths of a second after the pulse is sent out. But such extremely short time intervals can be measured, by the techniques of modern radar, with a precision which seems uncanny.

The transmitter and receiver of a radar set ordinarily share the same antenna as they work alternately. The transmitter sends its pulse (normally about a millionth of a second long), then waits for a relatively long time, during which the receiver is gathering the returning echoes, before sending out the next pulse. In order to establish the direction of a target, this common antenna is usually highly directional, so that echoes are received only from the direction in which the antenna is pointing. The antenna is arranged so that it can be moved mechanically to sweep the radar beam, like the beam of a searchlight, over the volume of space to be investigated.

Echo signals from radar targets are pulses like the outgoing pulse, but many times weaker. The transmitted pulse may be at a power level of millions of watts; the power in an echo seldom exceeds 10^{-10} watts, and may be much lower. Careful attention must be paid to the design of radar receivers in order to keep their inherent noise as low as possible, so that the weakest possible echoes can be distinguished.

Essential substance of an address presented before a meeting of the AIEE New York Section, November 14, 1945.

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The display of radar signals, except for special purposes, should reproduce the quantities—direction and range—given by the radar set. The most generally useful and most generally used display is called PPI, or *p*lan *p*osition *i*ndicator. In the PPI, the normally cut-off intensity grid of a cathode-ray tube is modulated with the output of the radar receiver, so that bright spots will appear on the screen of the tube only at the instant an echo is being received. The deflection of the cathode-ray beam is accomplished in two co-ordinates. A fast radial sweep outward is begun at the instant each transmitted pulse is sent out. This sweep is linear, and when the beam reaches the edge of the screen, it is returned to the center of the tube in readiness for the next transmitted pulse. Since the time elapsing between the transmitted pulse and the return of the echo is a measure of the range to the object causing the echo, bright spots representing echoes will occur along this radial sweep at distances from the center of the tube which are proportional to the ranges of the echoing objects from the radar.

The direction in which the radial sweep takes place is caused to correspond to the direction in which the antenna is pointing momentarily. Thus, we might agree that the top of the cathode-ray tube face corresponded to north, as measured at the radar antenna. Then, when the antenna is pointing east, the fast radial sweep which follows the transmission of each pulse takes place from the center of the cathode-ray tube horizontally to the right. When the antenna is pointing south, the radial sweep goes downward from the center of the tube, and so on.

The result of all this is that the PPI reproduces, in miniature, a plan view of the surroundings, showing all the radar targets in the vicinity in their proper relation to one another and to the radar set. The position of the radar set itself is in the center of this display and distances and directions of all targets are shown correctly.

Radar echoes are returned by objects which stand out sufficiently above their surroundings to be distinguishable from them; ships on the surface of the sea, coast lines, hills, buildings, aircraft or birds in the air, clouds containing precipitation, and the like. The relative strength of the echoes from different targets depends in a very complicated way on the wave length used by the radar, the aspect in which the target is viewed, and other factors.

A radar set is not able to distinguish two targets as separate unless they are separated in azimuth by more than the width of the radar beam, or in range by more than the distance corresponding to the length of a pulse, or both. As the width of the radar beam is proportional to the wave length divided by the width of the antenna, ability to resolve targets close together demands large antennas, short radio wave length, and short pulses.

This ability to resolve—to present a picture of high definition in the television sense—is so important that one of the major effects of the radar development carried on during the war has been to exploit regions of wave length which were laboratory curiosities in 1940. Most modern radar sets built during the war operated in the vicinity of 10-centimeter wave length, much air-borne radar operated near 3 centimeters, and even shorter wave lengths were being used as the war ended. Pulse powers attained by microwave transmitters were as high as 4 million watts, and the sensitivity of receivers was within a few decibels of the theoretical noise limit.

While the definition and resolution of PPI pictures produced even by the most modern microwave radars are somewhat disappointing to one who is used to the microscopic detail of visual photography, the absence of the effect of perspective, the ability to see under any conditions of optical visibility (through fog, rain, snow, or darkness), the provision of exact information on target range, and the great distances at which targets can be seen (200-mile range on a large airplane is not unusual performance), are all superiorities of radar vision to optical vision.

RADAR ON ALL FRONTS

The story of radar's participation in the war has been told so well and widely that only some of its bolder outlines need be sketched. From the early Pacific naval

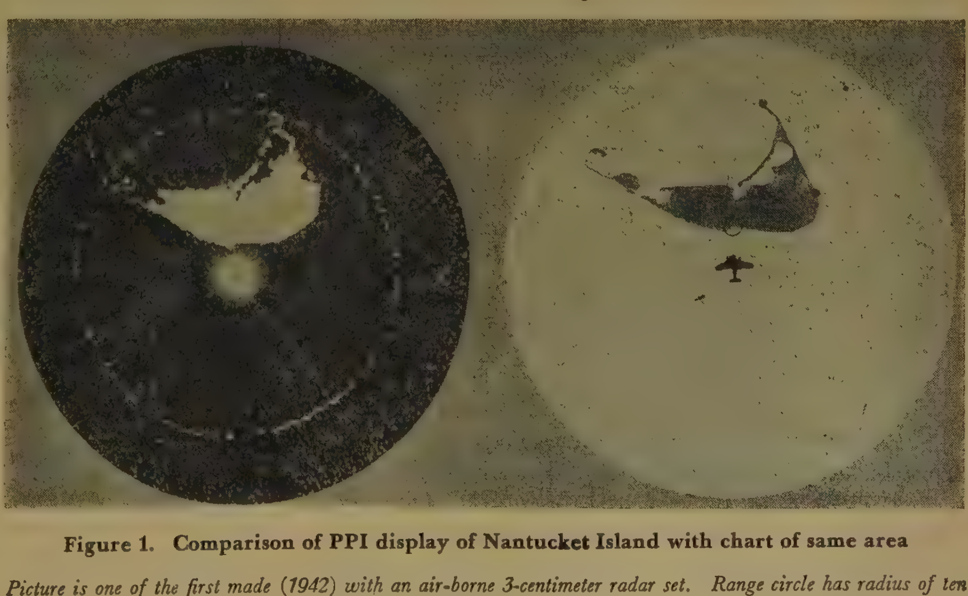


Figure 1. Comparison of PPI display of Nantucket Island with chart of same area

Picture is one of the first made (1942) with an air-borne 3-centimeter radar set. Range circle has radius of ten nautical miles

Figure 2. Scope shot of a typhoon taken by units of a United States Naval Force operating off the Philippines on December 18, 1944

Typhoon, not yet fully developed, was moving in a west-northwesterly direction at an accelerated speed with seas at plus 40 feet. Eye of typhoon is clearly visible

battles and the Battle of the Atlantic to the final capitulation of Japan, reeling under blows from radar-guided B-29s, radar was one of the main technical superiorities the United States enjoyed over its enemies.

At first, it was thought that radar's only use was in air defense, and its success in this role during the Battle of Britain strengthened this impression. While radar never lost its usefulness in this defensive role, it promptly was forged into a weapon of offense as the war went on.

Air-borne radar played an indispensable part in the Atlantic antisubmarine campaign which reached its peak during the spring and summer of 1943. The then-new microwave sea-search radar dealt the U-boat fleets a blow from which they never recovered, and so destroyed the morale of the German submarine service that their psychology changed entirely from one of attack to one of defense. During much of 1943, U-boats were sunk at a rate not far from one per day, two-thirds of them by aircraft attack. Most of these attacks developed from radar contacts.

The accuracy of antiaircraft fire was increased greatly by the development of radar position-finders which gave accurate target range under all conditions of visibility, and could, at night or in overcast conditions, also give directional information nearly as good as that available from optical tracking of the target. The most spectacular successes of radar-guided antiaircraft batteries came in the defense of London (and later of Antwerp and Brussels) against attacks by the German V-1 buzz-bomb. The defense efficiency achieved in these campaigns, after an initial shake-down period, quickly reached a figure of better than 90 per cent, which reduced V-1 from a serious threat to a bothersome, but insignificant, irritation. Most of the success of the V-1 defense is attributed by the British to the superb radar with which the American batteries were equipped.

As the Eighth Air Force built up in strength during 1943, it became obvious that the poor target visibility which characterizes European winter weather seriously would limit the operations of this great strategic air force unless some device which permitted the bombing of unseen targets were available. Radar did this job, too. By the fall of 1943, an experimental squadron equipped with radar designed to permit bombing through the overcast, or through the artificial smoke with which the enemy blanketed his cities, was available to lead the combat airplanes of the Eighth Air Force. In December 1943, the Eighth Air Force equalled the Royal Air Force Bomber Command in tonnage dropped, and in January 1944, it surpassed the RAF tonnage—though in all this period there were only four raids in which visual sighting of the target was possible. The rest of the bombs were aimed by radar.

By the time the B-29s were dispatched to the Pacific for the strategic air campaign against Japan, the necessity of radar bombing equipment for a strategic air force was obvious. Each B-29 was fitted with a radar bombing device. These found considerable use, for the Japanese weather, in respect to target visibility, is con-

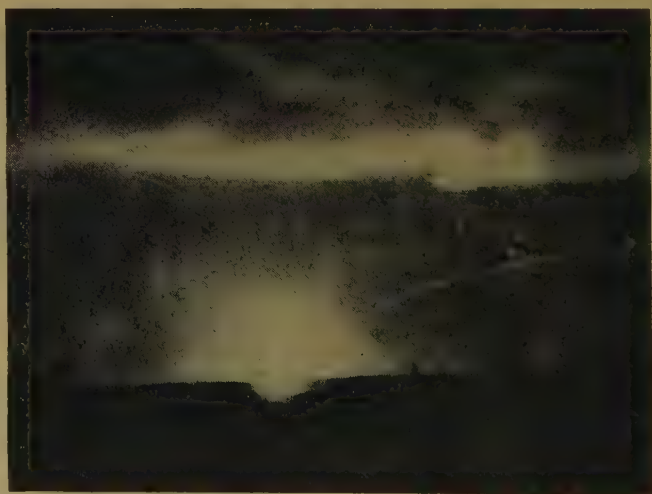


Figure 3. Time exposure taken on the south coast of England in August 1944 showing the interception of a buzz bomb by 90-millimeter radar-aimed fire

Streak of light at right is caused by glow of V-1's jet engine while flash indicates bomb's explosion. Predicted gunfire, evidenced by dots of light, follows path bomb would have taken if it had not been shot down. Equipment used was similar to antiaircraft radar position finder illustrated in title photograph

siderably worse than that in Europe.

A concrete example of the way in which a radar can be transformed from a defensive to an offensive role is afforded by a large ground-based microwave radar which reached the European war in the spring of 1944. Its designers first conceived this set as a fixed installation to give long-range coverage against low-flying enemy aircraft for supplying early warning to the air defense organization. By the time it was available for use in the war, the United States had achieved substantial mastery of the air, and the need for an early warning radar was very small. The set first was used, from a fixed site on the English side of the English Channel, for controlling offensive sweeps made by friendly fighters against then-occupied France. Its success in this role was so great that several similar sets were rebuilt, in Europe, to be transportable. These were carried along with the control organizations of the United States Army Air Forces Tactical Air Commands, and used for the control of friendly fighter-bombers during and after the invasion of Normandy.

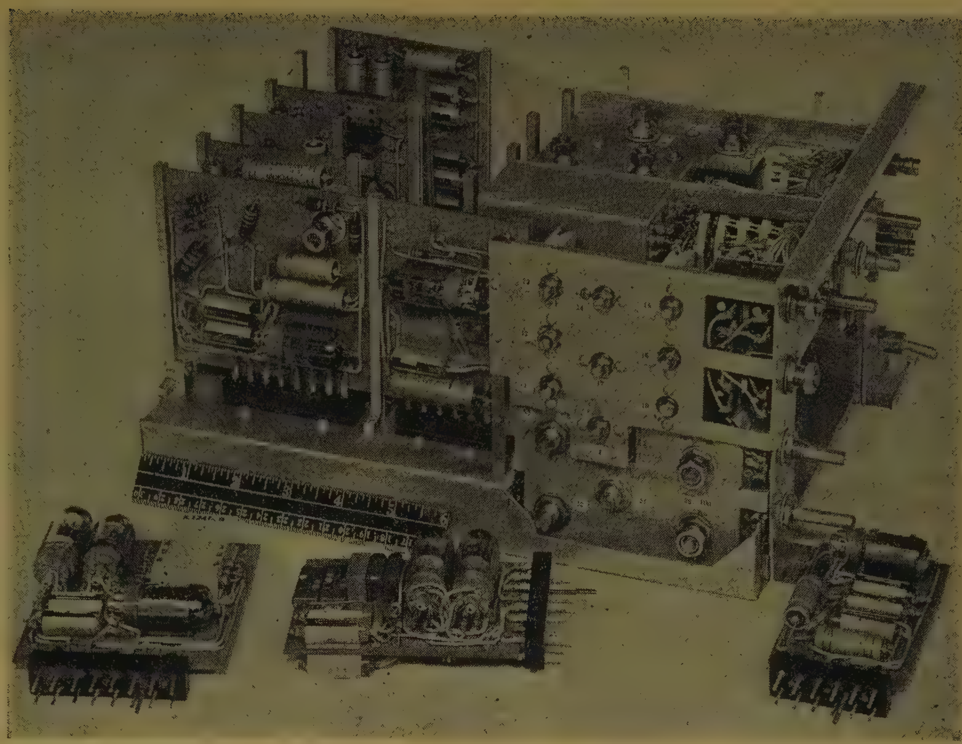


Figure 4. Chassis illustrating extreme compactness made possible by use of miniature techniques and flexibility afforded by detachable subassemblies

Unit measures 6 inches by 9 1/2 inches by 12 inches and contains 50 tubes as well as some bulky mechanical components

In its new offensive role, the set was phenomenally successful. It enabled fighter-bombers of the Tactical Air Commands to be guided to their targets and brought back to their bases under conditions of poor visibility. It enabled American fighters to tackle the occasional Luftwaffe sorties under the most favorable conditions; and, in the hands of the strategic air forces, it enabled rendezvous of bomb formations and escorting fighter groups to be made with ease and precision at distances up to 200 miles from the radar station.

Not more than a brief sketch of some of the ways in which modern radar contributed to the winning of the war has been attempted here for, after all, the war is won. The pertinent question is, "What is the place of radar in the postwar world?"

RADAR IN THE POSTWAR WORLD

Clearly, the chief direct and immediate contribution radar can make to a peaceful world lies in its ability to render air and sea navigation entirely safe, continuous, and foolproof, regardless of visibility. Long-range pulse navigation schemes closely related to radar can be relied upon for en route navigation over the broad expanses of the air or the sea. Collisions of ships with icebergs or derelicts, or of aircraft with mountains, buildings, or other aircraft may require the further provision of radar equipment integral with the vessel. Such integral radar also will provide independent means for the vessel to navigate by pilotage in harbors or narrow waters, or near airports.

In addition to the devices already mentioned, two other adjuncts of modern radar promise to be useful in the problem of air and sea navigation and traffic control. These are the radar beacon, and means for relaying radar displays by a radio link from the station where they are obtained to distant points.

The radar beacon is an echo magnifier in principle. It is a device with a receiver whose output is caused to trigger a transmitter which sends back a strong pulse, or coded sequence of pulses, to the radar set whose pulse caused the triggering. The time delay between reception of a radar pulse by the beacon and transmission of the reply pulse by the beacon receiver can be kept very small, and in any case is kept constant, so that range and direction to the beacon can be measured in just the same way as range and direction to any radar target are measured. The beacon has the advantage that its reply is very strong compared to an echo, so that

it can be seen at great distances, and further that, since its reply can be coded in a characteristic way, unique identification of each beacon is possible. In effect, the beacon is a radar lighthouse.

By means of more or less standard television techniques, the video signals coming from a radar receiver, and suitable synchronizing signals, can be applied as modulation on a wide-band carrier, and the vital information provided by a radar set thus transmitted to a radio receiver at a distant point. The output of this radio receiver can be used to operate a PPI, or another type of radar indicator. Thus, with a relatively light and simple installation, the complete display of a heavy and powerful radar set can be reproduced at other places. This has been suggested, for example, as a means of providing commercial airliners with a continuous radar display, relayed to them from powerful radar stations along the airways, without necessitating the carrying of integral radar equipment in the airliner itself.

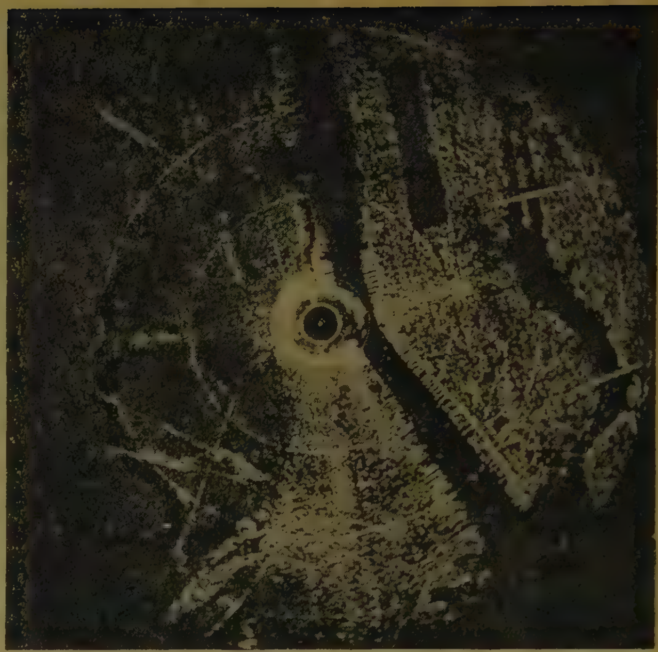


Figure 6. Lower Manhattan as seen on the PPI of an air-borne radar set

The outline of Central Park can be distinguished as well as docks along the Hudson River, bridges over the East River, railroad lines in New Jersey, shipping in the rivers and harbor, and so forth. Difference in radii between successive circles of constant range is one mile. Small blank spot in the center is due to the absence of signals out to a range corresponding to the altitude of the aircraft

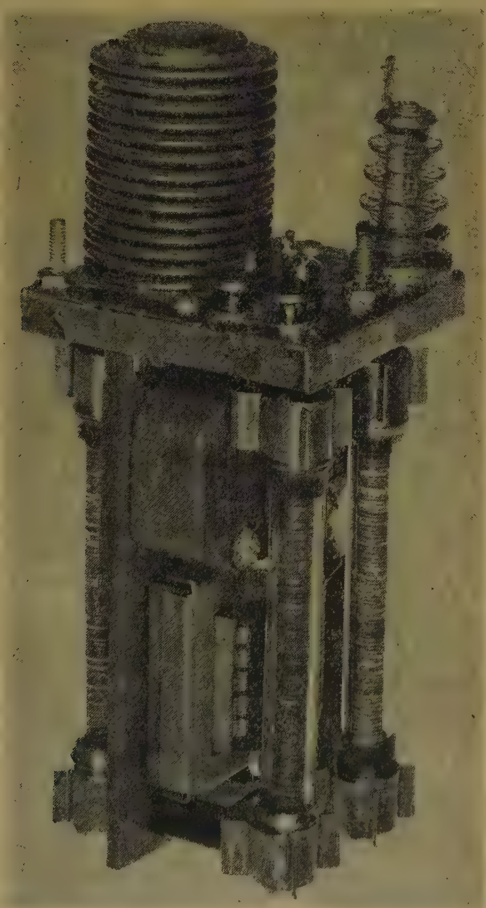


Figure 5. Miniature high voltage supply for cathode ray tube (approximate size)

External 6V6 tube is used as an audiofrequency oscillator. Can contains transformer (2,500 cycles), selenium rectifiers, and filter. Bellows is for expansion of cooling oil

At present, it is not clear just how these various types of radar and allied facilities will be integrated into a navigation and traffic control system for the air lanes and sea lanes of the world. It is clear, however, that the embarrassment of decision is one of riches. Pulse navigation systems, integral radar, radar beacons, and relay radar, considered together, provide more than sufficient facilities for coping with the problems of en route navigation and of pilotage in the vicinity of harbor or airport.

In the case of aircraft, the problem of actual landing approach is also an important and difficult one. Present systems of instrument approach are adequate from the point of view of safety, but their traffic-handling capacity is so low that serious jams occur even today at major airports under instrument conditions. Several schemes, of which one of the most promising is GCA (ground-controlled approach) radar, have been designed to deal with this problem. The GCA is ground-based equipment of high resolution which displays to a ground controller sufficiently detailed and accurate information of the position of an aircraft on final approach to permit the controller to "talk" the plane into its correct glide path by radio instructions to the pilot. It thus requires no additional equipment in the airplane, beyond the communications equipment which must be carried

anyhow. In use by the Army Air Forces at the end of the war, this system gained much favor for its simplicity and effectiveness. It is not clear that the finally adopted landing aid will be GCA; but it is clear that microwave radar offers a facility which can do the job.

HERITAGE OF RADAR

Not the least important of the effects produced by the wartime work on microwave radar is the detailed improvement in techniques vital to many branches of engineering, and to scientific instrumentation for many purposes. In the brief scope of this article, it will be possible to mention only a few outstanding examples.

One of the most spectacular is the great extension of the radio-frequency spectrum. At the beginning of the war, 200 megacycles per second was considered about the highest frequency for which radio techniques were routine. At the end of the war, this limit had been extended to upward of 20,000 megacycles per second. On the assumption (which is nearly realizable) that the width of channel required for a radio service is fixed by the band-width required for the service, with small allowance in channel spacing for frequency instability, this means that the number of available radio channels has been multiplied a hundredfold. Actually, since microwaves are not reflected from the ionosphere and ranges do not extend much beyond the optical horizon, the number of services which can be maintained in the United States or in the world has been increased still further.

The necessity for exact measurement of radar range has vastly improved the ability to time small intervals. The radar antiaircraft position finder, for example, routinely measures range to an accuracy of about 15 yards, which means a measurement of time accurate to the nearest tenth of a millionth of a second. With a little care and attention to details, similar sets (which have been used to track shells, bombs, and rockets in flight for the establishment of ballistic tables) have measured time accurate to plus or minus a hundredth of a microsecond.

A third important advance was brought about by the need for making the complicated circuits of radar light, compact, and economical of power, in order to cut down the expense of installing radar in high-performance aircraft. This has led to many striking advances in the use of miniature components such as tubes, resistors, and capacitors, and in design and assembly techniques which exploit to the fullest the inherent compactness of these components. The use of sockets, universal before the war, carries the implication that vacuum tubes are interchangeable (and thus that they are the least reliable circuit components and the most likely to need changing), and provides the most important tie points for the wiring. The modern trend has been to wire the tubes directly into the circuit which saves the bulk and weight of a socket. Furthermore, it assumes that the tubes initially installed in a circuit will not be changed, so that the circuit constants do not have to be arranged to accommodate the whole range of variation in vacuum tube properties. This enables much more efficient circuit adjustment and operation. High-frequency a-c power supplies also have been exploited to cut down the weight and bulk of transformer–rectifier–filter combinations.

Tremendous improvements in the design of cathode-ray tubes and in sweep circuits and auxiliary equipment followed the manufacture of tens of thousands of radar indicators during the war. It seems safe to predict that the cathode-ray tube indicator will be used as a precision device for the display of data in most postwar instrumentation involving rapidly varying quantities.

The United States invested more than 200 million dollars in radar research and development during the war years, and more than ten times that in the manufacture of service radar equipment. Ten thousand or more technical man-years were spent on development and engineering design. The fruit of all this work and money was not merely a weapon, though a superb weapon which was decisive in many campaigns did result, but also a variety of powerful and promising techniques which will make their influence felt far from the narrow field of radar.

Figure 7. TR boxes, devices which switch radar receivers to and from the antennas 1,000 times a second (approximately half size)

The switch is essentially a needle spark gap in a confined space containing gas at a definite pressure. A relatively large glass reservoir acts as a gas chamber and also as the necessary high voltage insulator

The Amplidyne

JOHN R. WILLIAMS

This article explains the characteristics and operating principles of the amplidyne generator by comparison with a conventional d-c generator. The fact that the amplidyne possesses the requirements for a perfect electric regulator, high amplification and fast speed of response, is emphasized, and several applications are described which illustrate the amplidyne's versatility.

AN AMPLIDYNE is an amplifier with the characteristics of a rotating machine. It is related closely from the standpoint of operating principle to the Rosenberg generator and the metadyne, differing principally in its use. The Rosenberg generator is a constant-current source of d-c electric power, the metadyne in its usual form is a machine for converting constant-potential d-c energy into constant-current d-c energy, while the amplidyne generator is a dynamoelectric amplifier.

A disassembled amplidyne generator is shown in Figure 1. Externally, it is similar in appearance to any d-c motor or generator. It has the necessary components of a rotating device and a d-c machine. The armature is electrically and mechanically of conventional type, but the stator structure internally resembles that of an induction motor.

The principles of amplidyne electrical performance can be explained best by comparison with a conventional generator, for example, a 10-kw 100-volt 1,750-rpm separately excited d-c generator driven by a prime mover of the proper horsepower and speed. For rated output a field excitation of 2,500 ampere turns per pole is required and approximately 100 watts are required to produce the necessary ampere turns in the magnetic structure. The amplification, therefore, is 100 to 1 and thus it is basically an amplifier.

The 10-kw generator is designed for 100-volt field excitation. With a resistance of 100 ohms and 2,500 turns per pole, a current of one ampere flows in the field circuit which produces a magnetomotive force and a flux which travels from pole to pole through the revolving armature. The rotation of the armature through this flux produces a potential of 100 volts across brushes placed at points where the armature conductors cut a minimum of flux. If a 1-ohm resistor is placed across these brushes, a current of 100 amperes flows out of the armature from the positive brush, and back into the armature at the negative brush. (Armature resistance drop is neglected.) This current flow produces the well-known "armature reaction" flux.

In general, the field and armature reaction fluxes may be considered numerically equal, but at right angles to each other. The armature reaction distorts the field flux by pushing it in the direction of rotation and from this it readily can be seen that armature reaction generally is undesirable. However, the amplidyne uses this same armature reaction flux to advantage. If a small voltage is applied to the field circuit, a small armature voltage will be generated which then will produce a large current flow in the short-circuited armature. Assuming 10 per cent inherent armature circuit resistance, 10 volts applied to the field will produce a current flow of 100 amperes at 10 volts in the armature circuit. This current will produce an "armature reaction" flux of the magnitude formerly obtained with full field excitation and a load resistor of one ohm.

The armature now is rotating through two fluxes; the small field flux and the armature reaction flux. The voltage generated by rotation through the field flux is used by the short circuit, but the voltage developed by rotation through the armature reaction flux is still available for use. As the armature reaction flux is numerically equal to but displaced 90 degrees from the excitation flux produced by the former field with 100 volts applied to it, the second armature voltage equal to 100 volts is available at points displaced 90 degrees from the first.

In Figure 2, two additional brushes are shown displaced

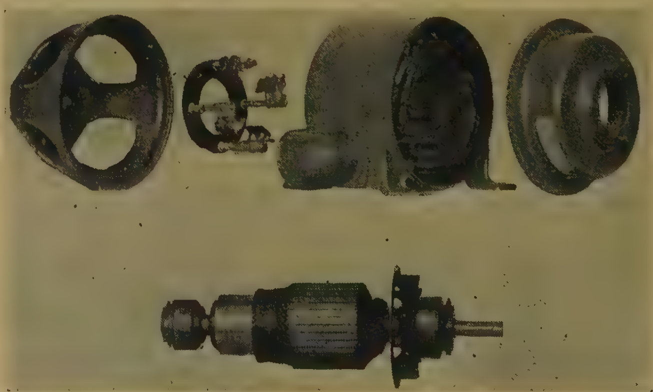


Figure 1. View of disassembled amplidyne generator

Essential substance of an address delivered before a meeting of the AIEE Philadelphia Section, May 1945.

John R. Williams is in the apparatus department, General Electric Company, Philadelphia, Pa.

placed 90 degrees from the original brushes, and across them appears the rated potential of 100 volts.* If the original 1-ohm resistor is placed across these brushes, a current of 100 amperes will tend to flow, but the flow of current into this resistor produces a second component of armature reaction flux as shown by the solid circles.

From the flux vector diagram it is apparent that this second component armature reaction flux is in direct opposition to the small control field flux. Because it is much larger than the field flux, the load armature flux will collapse the circuit and both the load voltage and current will decrease to a small value. To avoid such an occurrence, a compensating field coil, mechanically situated on the field poles and electrically connected in series with the load, is added to the machine. This compensating field produces ampere turns in direct opposition and numerically equal to the ampere turns produced by the load current. The net effect during steady states is to leave two operating fluxes, that is, the control field flux and the short-circuit armature reaction flux. The field power is now only 1 watt and produces 250 ampere turns and is controlling 10 kw on the armature side of the circuit. Thus the amplification is 10,000, a decided improvement over the conventional 10-kw generator which has an amplification of only 100.

From the foregoing, it can be seen that the first requirement of a good regulator, high amplification, has been met. A machine still is needed, however, which will respond rapidly to a change in control field power. In the conventional 10-kw generator, after the voltage has been applied to the field, approximately 1/2 second is required until the armature has 100 volts across its brushes. This delay is due to the time of build-up of the field current.

In all types of machines, the ratio of inductance to resistance can be decreased by design changes and, consequently, the time of voltage changes also can be decreased. For example, the 10-kw conventional generator can be made to build up in the fast time of 0.05 second by a change in this ratio. Such a procedure, however, increases the power needed for excitation to such an extent that 5 kw is required. With the 10-kw armature output controlled by 5 kw, the amplification would be only 2 instead of the normal 100. Yet the amplidyne has an extremely fast build-up time and still retains its high amplification.

* In this and succeeding diagrams the compensating and main field winding have the same magnetic axis as the armature load current.

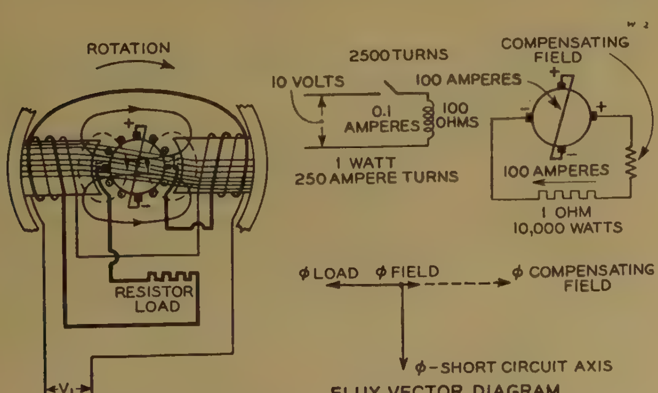
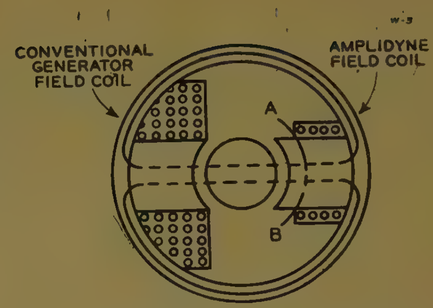


Figure 2. Diagrams of amplidyne generator

Amplification = 1 watt to 10,000 watts or 10,000
Build-up time = 0.05 second

Figure 3. Comparison of field coil sizes and inductances of conventional and amplidyne generators



$$\text{Inductance} = \frac{N\phi}{I} \qquad \phi = \frac{K \cdot N \cdot I \times \text{area of magnetic circuit}}{\text{length of magnetic circuit}}$$

(K = *permeability*, N = *number of turns* I = *coil current*, ϕ = *flux*)

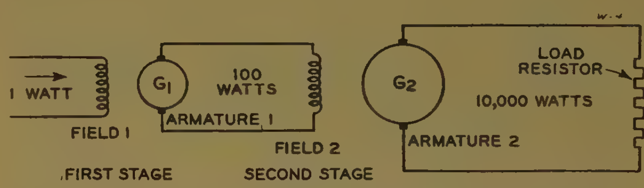


Figure 4. Two stage power amplification using two machines
Amplification = 1 watt to 10,000 watts or 10,000

In Figure 3 a rough comparison of the field coils of a conventional d-c generator and an amplidyne generator is shown. As previously stated, conversion of a conventional 10-kw generator to an amplidyne reduces the field excitation from 2,500 to 250 ampere turns, which permits a further decrease in the physical size of the pole structure as less material is needed to accommodate physically the field coil. Because of this, the portion of the pole which is nonessential (A–B) can be removed and the remaining pole and field coil can be brought closer to the armature. From the formula in Figure 3, it can be seen that a reduction of the length of the magnetic circuit will produce a larger flux per ampere turn. Such a reduction is cumulative and the final result in a 10-kw amplidyne is:

1. A field excitation requirement of 25 ampere turns at 1/5 watt.
2. An amplification of 50,000.
3. A magnetic structure which responds rapidly to a change in excitation power.

However, there is one other feature which contributes to the speed of response in an amplidyne—the armature circuit. Armatures have minute inductances as compared with field circuits and armature voltages change almost simultaneously with changes in the field flux

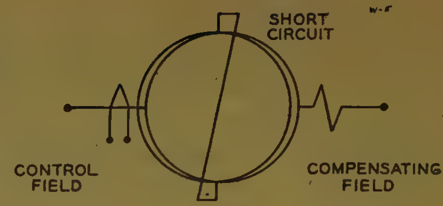
strength. Due to the short-circuit axis and the additional set of brushes, an amplidyne is a 2-stage amplifier and can be compared to two d-c generators in cascade. Figure 4 illustrates a 100-watt machine exciting a 10,000-watt unit. Each machine is assumed to have an amplification factor of 100, so the total amplification is equal to 10,000. The amplidyne combines this double amplification in a single machine.

The control field of the amplidyne corresponds to field 1. The armature and short-circuit axis correspond to the armature of generator 1 and the field of generator 2, and the amplidyne armature to the armature of generator 2. This explains the amplidyne symbol which is given in Figure 5. Because of the minute field circuit inductance and the 2-stage amplification in the armature circuit, the amplidyne builds up to 100 per cent voltage in 0.05 second. Figure 6 compares the conventional and amplidyne generators.

Basically, the amplidyne can be utilized as a voltage regulator, a current regulator, or as a speed regulator. First, consider the amplidyne controlling voltage. A cardinal principle of a regulating system is that an ideal or standard must be used as a reference for performance. This can be illustrated by a brief review of a mechanical regulator with a system as set up in Figure 7. Here a conventional generator is used to supply several small motors. The inherent load characteristic of the generator is a drop in voltage from no load to full load. To correct this, a mechanical regulator consisting of a spring balanced against the magnetic force of a coil, and a resistor stack, is used to vary the generator field current and to maintain a constant value of generator voltage V_2. The coil is placed across the generator lines and will produce a force proportional to the voltage V_2. Any variation of V_2 from the desired value upsets the balance of the spring and the coil, and the resistor stack then is adjusted to change the field current to return V_2 to the desired value. In Figure 8 the amplidyne is shown performing the same function.

To follow the principles of regulating systems, one field comparable to the spring of a mechanical regulator is used as a reference field and is excited separately. A second field is placed across the generator lines which compares to the coil of the mechanical regulator. This field is the voltage control field and is in opposition to the reference field. Because of the small space required for amplidyne control fields, 4, or even 5, may be incorporated in the amplidyne stator structure without sacrifice of size or operation. As practically all amplidynes from 200 watts to 20 kw require only 25 ampere turns for full excitation the reference field which produces positive amplidyne output must be 25 ampere turns larger in strength than the voltage control field. The reference field is designed for approximately 125 ampere turns and the voltage control field for 100 ampere turns which leaves a net of 25 ampere turns when the voltage V_2 is at its 100 per cent value. Using field strengths of large ampere turn values makes adjustment to 25 ampere turns simple and, in addition, provides a source of forcing power for the amplidyne. For example, when the external voltage V_1 is applied to the reference field, the 125 ampere turns force the amplidyne to build up at the rate of 2,000 volts per second for a 125-volt machine or at 4,000 volts per second for a 250-volt machine. The change in net ampere turns in the amplidyne is shown in Figure 8*A*. Figure 8*B* shows a similar curve which illustrates the voltage wave produced by the amplidyne armature as the ampere turns travel their portion of the cycle. The difference between the peak of the voltage wave and the steady state value as given in Figure 8*B* illustrates the forcing characteristic of an amplidyne which removes the time delay caused by the generator field inductance.

Figure 5. Amplidyne symbol (two stage power amplification in one machine)



As the generator field current and armature voltage build up, the voltage control field also builds up until 100 ampere turns are produced. At this time, only the necessary 25 ampere turns are available for excitation which is the needed amount for 100 per cent voltage. If motors are loaded on the system, the generator voltage V_2 also changes, but is held constant by the amplidyne in this manner. Assume that V_2 tries to drop to 90 per cent which would weaken the voltage control field to 90 per cent of 100 ampere turns. This would leave a net excitation in the amplidyne of 35 ampere turns which

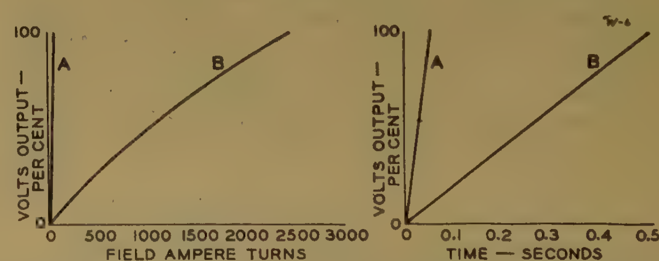


Figure 6. Output voltage build-up of conventional and amplidyne generators

A—10-kw amplidyne
B—10-kw d-c conventional-type generator

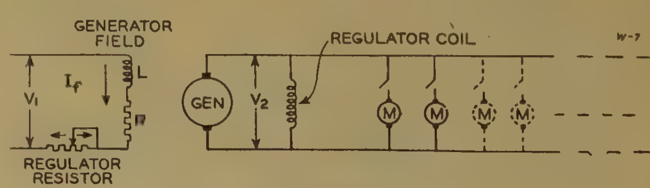


Figure 7. Mechanical regulator holding constant voltage

would boost the amplidyne output and increase the generator field current and the voltage V_2. This, in turn, strengthens the voltage control field until it again has a strength of 100 ampere turns when V_2 is again equal to 100 per cent and again the net of 25 ampere turns exists in the amplidyne. The reverse is true if motors are removed from the system and the voltage V_2 tries to rise. Figure 8*C* demonstrates the rapid change in generator field current as motors are loaded and unloaded from the system.

Figure 9 shows the amplidyne acting to maintain constant current flow into the battery independently of the rise in battery voltage with an increase in the state of charge. Again two control fields are used, one the reference field and the other a current control field excited from the resistance drop across a shunt connected in the generator line which is directly proportional to the load current *I*. As the battery becomes charged, its voltage rises and the difference between the generator and battery voltage decreases, tending to lower the current *I*, to decrease the resistor drop across the shunt, and to decrease the strength of the current control field. The final effect is that the reference field boosts the amplidyne output and increases the generator field current and generator voltage until current *I* is back to its 100 per cent value.

The amplidyne used as a speed regulator is portrayed in Figure 10. The speed of a d-c motor whose field is excited separately from a constant voltage is proportional to the voltage applied to the motor armature terminals. If load is applied, the motor speed will tend to drop because of the inherent characteristics. To hold constant speed independently of load, the amplidyne must adjust its armature voltage V_2. In the amplidyne, two fields again are used; the reference field and a speed control field. A small permanent-magnet generator driven from the motor shaft supplies a voltage to the speed control field which is proportional to the motor speed. Any deviation of the motor speed produces a change in the strength of the speed control field and thus changes the amplidyne output to bring the motor speed back to the desired value.

In all of the foregoing cases the control fields were used for regulating purposes. They also may be used to function as limits (Figure 11) in an adjustable-voltage variable-speed d-c drive in which the amplidyne is substituted for the conventional exciter for the generator. The reference and voltage control fields are very similar to the system previously described (Figure 8), except that an adjusting rheostat has been added to the voltage control field to raise or lower the generator voltage which is held at any preset point determined by the position of the rheostat arm.

However, now added to the system are current and speed limit fields to each of which have been added a source of external d-c power and a blocking rectifier either of the copper oxide or selenium type. For explanatory purposes, the current limit circuit has been shown alone at the right-hand side of Figure 11. The output of the external direct current is opposed by the resistance drop across the shunt and the current limit field is placed between these two opposing voltages. If the external direct voltage is higher than the shunt voltage, current will flow to the right. However, this would cause the current limit field to aid the reference field and instead of limiting would increase the current. To avoid this, a rectifier is used to block current flow into the shunt and current is allowed to flow only from the shunt into the external d-c source. This flow occurs only when the shunt resistance drop is higher than the external direct voltage. With such an arrangement, the current field is inactive until the generator load current becomes high enough to produce a resistance drop across the shunt higher than the external direct voltage, at which point the current limit field opposes the reference field, thus finally weakening the generator field and, consequently, lowering the generator voltage and current.

The same principles apply to the action of the speed limit field. When the motor speed is excessive, the speed voltage generator passes current through the speed limit field and bucks the reference field. The final result is a lowering of the voltage V_2 and a return of the motor speed to normal.

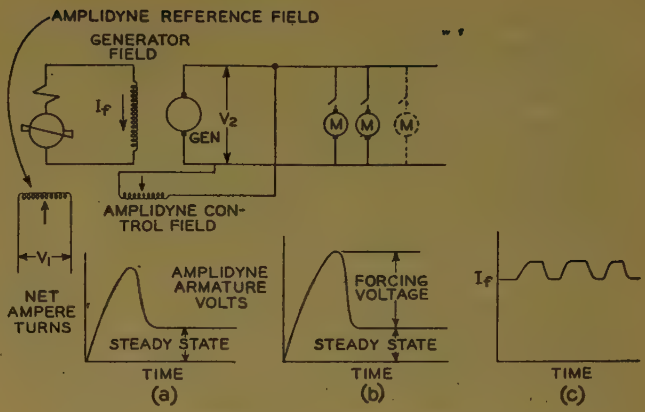


Figure 8. Amplidyne acting as voltage regulator

A—Change in net ampere turns in amplidyne
B—Voltage wave produced by amplidyne armature
C—Change in generator field current where amplidyne is used

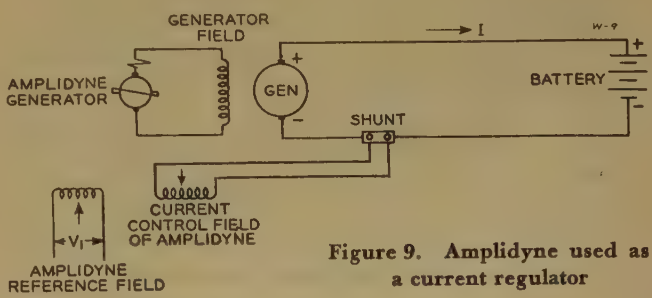


Figure 9. Amplidyne used as a current regulator

These basic types of control circuits can be combined in many ways to give:

1. Voltage regulation with current limit.
2. Current regulation with voltage limit.
3. Either voltage or current regulation with speed limit.
4. Speed and voltage control with current limit.
5. Speed control with current and voltage limits.

In Figure 12 the control for a d-c generator feeding several d-c motors on an electric power shovel is shown. The problems involved are recognized readily as the bucket must be reversed with either lifting or overhauling loads. In addition, severe strains and shocks are placed on the equipment. This control circuit employs voltage control with current limit.

1. Current limits, both plus and minus, protect the complete equipment from excessive electrical loads and mechanical strains as shown in Figure 13.

2. The d-c motors can be plugged and reversed without excessive current flow during low speeds or stalled conditions.

3. The combination of voltage control and current limit forces the load to a maximum under rapidly changing conditions thus increasing production by maintenance of the highest rate of acceleration and deceleration.

Such a system is suited for skip hoists, machine tools, steel mill apparatus, and saw mill carriages.

A useful characteristic of the amplidyne is its ability to control the position or speed of several machines from a master control. For example, where two d-c motors are supplied from a constant voltage bus, the field of motor 1 with an adjusting rheostat also is supplied from this bus, but the field of motor 2 is excited by an amplidyne generator. The amplidyne has both a reference field and a speed control field. To the shafts of each motor are coupled speed voltage generators and the speed field of the amplidyne is placed between the opposing voltages of the speed voltage generators. With this arrangement a difference of the motor speeds excites the speed field to either buck or boost the reference field and bring the motors back to similar speeds. Adjustment of the rheostat in field 1 will change the speed of motor 1 and the amplidyne rapidly changes field 2 to bring the two motor speeds in step with each other.

Variations of this speed control scheme are used also

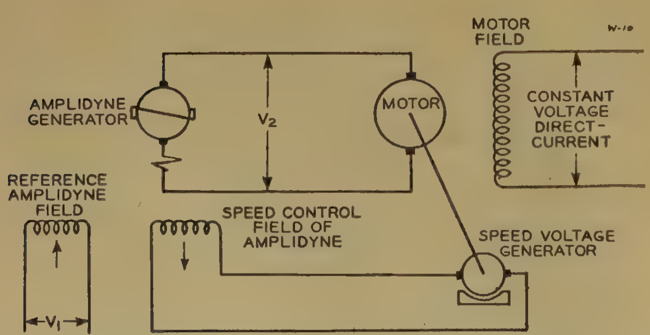


Figure 10. Amplidyne used as a speed regulator

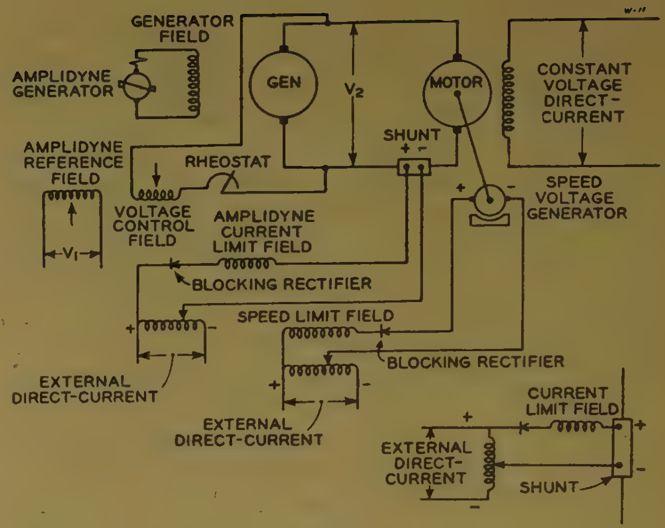


Figure 11. Amplidyne-controlled adjustable-voltage (Ward-Leonard) drive with voltage control and speed and current limits

to control remotely the static positions of machines as, for example, where the cutting heads on a boring mill have been adjusted automatically and accurately to 0.001 inch.

Another example of positioning is the application of the amplidyne in the process of paper or textile manufacturing which requires the straightening of moving rolls. In this process a reel shifting motor is used to shift the roll to the right or left as required. Projected onto the paper edge is a light beam which is reflected from the paper into a phototube whose output is proportional to the value of reflected light. The phototube is focused upon the moving edge of paper and any deviation of the edge varies the amount of reflected light and consequently varies the output of the phototube. An electronic device receives and amplifies the phototube output and supplies the increased power to the amplidyne fields. The amplidyne armature feeds the reel shifting motor and when the paper edge is in the proper position the control fields are of equal and opposite strength and consequently the amplidyne output is zero. However, any change in the position of the moving paper edge unbalances the amplidyne field circuit and the reel shifting motor then acts to correct the deviation.

An excellent combination is that of an amplidyne with vacuum tubes which are inherently fast in operation, are dependable, inexpensive, and easy to obtain. The low wattage required for amplidyne fields makes it possible to use high vacuum tubes as controlling or composing means. For example, a signal of 0.0001 watt is amplified by a tube to 0.01 watt and again by another tube to 1 watt. The power level of 1 watt can be applied to the field of a 10-kw amplidyne which is sufficient to excite a 2,500-kw generator and thus a total amplification of 25 billion to 1 is obtained. An illustration of

the vacuum tube and amplidyne combination is its use to control a flying shear which cuts a continuous sheet of steel into smaller lengths. It is very essential that these lengths of cut steel be consistent and also accurate within themselves. This accuracy had been maintained by mechanical ties holding the stand and shear motors in synchronism. When amplidyne control was placed in operation, the accuracy obtained was better than 1/4 of 1 per cent and was maintained even after the mechanical parts had begun to show signs of wear.

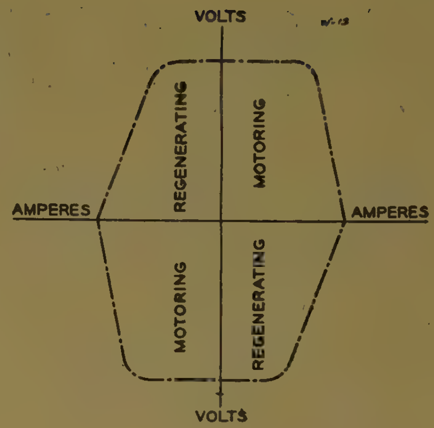
So far the amplidyne has been described as controlling d-c machines only but it also is useful to hold constant voltage and provide current limit on a-c generators. When used with synchronous motors, the amplidyne will hold constant power factor, or reactive kilovolt-amperes, or a combination of both, irrespective of load changes. In this case the synchronous motor field is excited from a conventional d-c exciter which, in turn, is excited separately from an amplidyne which acts to adjust the exciter field current. Three fields are used in the amplidyne. One functions simply to limit the range of exciter output voltage; the remaining two fields control the amplidyne output to hold the desired result on the synchronous motor. The benefits of this system, which are provided automatically by the amplidyne, are:

1. Increase in effective system capacity.
2. Improvement in voltage regulation.
3. Improvement in efficiency at light loads.
4. Increase of pullout torque at light loads.
5. Maintenance of normal voltage at no load and at heavy loads.

This description of the amplidyne generator, in an effort at clarity and brevity, has presented but a few fundamentals of its operation and applications. Nothing has been discussed in regard to suppression of oscillations generally always prevalent in systems with inherent high amplification and negative feed-back features, and although antihunt transformers and capacitors usually are provided with amplidyne controlled equipment the subject is beyond the scope of this article.

It can be seen, however, that the amplidyne is an extremely useful engineering tool. Its value was recognized immediately by the electrical industry although present knowledge indicates that its utilization has just begun. As for future prospects, it is expected that many new developments and applications, as yet still in the potential stage, will be made practicable through the use of the amplidyne.

Figure 13. Performance curve showing load limits without overshooting during stalled or plugging operations



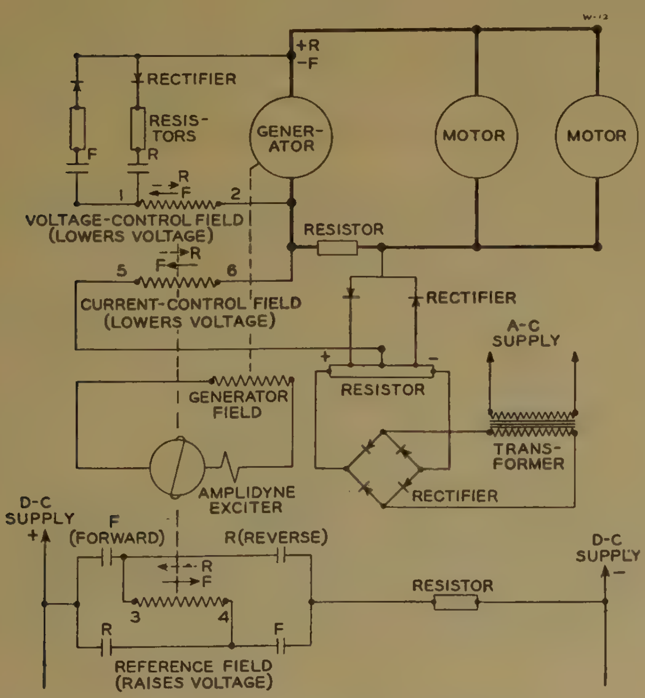


Figure 12. Control for d-c generator feeding several d-c motors on an electric power shovel

Railroad Switch Deicers

A deicing or ice-prevention unit, comprised mainly of wrought iron pipe and an electrical heating element, has been devised by the Cleveland Railway Company, Cleveland, Ohio, to prevent track switches from freezing. Wrought iron was selected because of corrosive conditions encountered, especially from salt which is used to clear streets of ice and snow.

The unit runs parallel to the full length of the switch, buried about a foot deep. The deicer warms the area surrounding the switch so that snow is melted as it falls on the warm pavement, residual water is evaporated, and ice is prevented from forming.

The heaters are controlled by a switch located in a box set high on an adjacent line pole. During bad weather, the units are turned on and left in continuous operation. When prolonged periods of mild weather are indicated, the heaters are turned off. It requires approximately four hours to make the switches "iceproof" after the heaters are put into operation from a cold start according to transit system engineers.

INSTITUTE ACTIVITIES

Fullest Program Since 1941

Planned for Detroit Summer Convention

For the 61st annual summer convention of the AIEE, to be held in Detroit, Mich., June 24–28, 1946, the summer convention committee has planned a program of entertainment, inspection trips, and recreation complementing the excellent technical sessions, which should enhance the attraction of the convention as a vacation as well as a benefit professionally. Convention headquarters will be at the Hotel Statler located in the heart of downtown Detroit.

TECHNICAL PAPERS

Many papers covering a wide variety of subjects in the field of electrical engineering will be presented in the technical sessions scheduled during the week of the convention. These will be listed in the June issue of *Electrical Engineering*, as well as in the announcement folder which will be mailed from AIEE headquarters. Among the sessions and conferences to be held, increased activity in the following fields will secure especial attention from many engineers.

ELECTRONICS

Two technical sessions, a technical conference, and two joint conferences will be arranged under the auspices of the committee on electronics. One entire session will be devoted to papers on new or improved types of tubes, their performance characteristics, or their design features. The session has been planned to appeal to engineers with particular interest in tube design and manufacture and in ways in which these factors are influenced by the basic circuits or broad fields of application.

Electronics is finding a place in nearly every field of electrical engineering. Some of its applications represent new devices or methods that perform tasks previously impossible. Others represent ways of accomplishing an old result by a newer, better, or lower cost method in which electron tubes are employed. Papers on both types of application will appear throughout the various sessions as well as in a session devoted entirely to electronic applications.

In a conference on electronic power conversion a comprehensive report on inductive co-ordination aspects of rectifier installations will be presented, as well as a proposed standard on pool-cathode mercury-arc power converters. Another conference sponsored jointly with the committee on education will deal with the place of electronics in electrical engineering curriculums. Still another, to be held jointly with the committee on instruments and measurements, will concern electronic instruments.

INSTRUMENTS AND CONTROL

A session on instruments and measurements will cover a wide range of subjects. Use of wartime techniques in peacetime applications will be emphasized. Papers on instruments and measurements related to power transformers, aircraft, instrument manufacture, telemetering, and power transmission are expected to be presented.

Because of wartime restrictions on the publication of technical material in the field of servomechanisms and control, the professional societies were forced to abandon normal activities in this field. Many of these restrictions now have been lifted, and a session on servomechanisms arranged jointly with the committee on industrial control devices will afford an opportunity for the Institute to bring forward for discussion much of the accomplishments which were restricted during the war.

The newly established committee on industrial control devices will hold for the first time an entire session devoted to this subject. Papers discussing new advances in electric control devices and control circuits will be presented. One paper will report results of a series of tests on silicone varnish-treated magnet coils, and the probable advantages derived from the permissible increases in temperature with the use of this new kind of insulation will be discussed.

SAFETY

In a session on safety one of the papers will discuss lethal electric currents and their accompanying physiological effects. Another paper will deal with methods for safeguarding operators and workers from the hazards which may accompany the use of X rays and gamma rays of radioactive material in industry. A third informal presentation will consider the shock hazards of low-voltage circuits.

MANAGEMENT AND QUALITY CONTROL

A conference will be sponsored in this field by the AIEE subcommittee on applications to statistical methods. Several papers will be presented dealing with plant organization for quality control and meth-

This Detroit skyline will greet arrivals at the summer convention, June 24-28, 1946

ods of presenting results to management. Several outstanding executives also will discuss quality control from the point of view of management.

GENERAL INFORMATION

A number of other sessions have been arranged tentatively in the fields of basic sciences, central stations, communication, transportation, electric machinery, and industry. In the central station field alone there will be sessions on power transmission, power cables, automatic or supervisory control of air switches, automatic switching of capacitor banks, hydroelectric systems, and excitation systems. In the field of transportation, papers will be presented which will deal with electrical applications to aircraft, railways, and installations on shipboard. As Detroit is one of the great industrial centers of the country, the problems of industry will be highlighted in all of the technical sessions and conferences. Two sessions will deal exclusively with problems in electric welding, and two others with industrial power applications.

ENTERTAINMENT FEATURES

Excellent programs for both men and women have been planned by the hospitality and sports committees. Among the social events planned for the men are an American League twilight baseball game (Detroit versus Boston), the president's reception and cocktail hour, a smoker with dinner and entertainment, and a moonlight boat excursion.

An extensive program also is planned for the women. An informal get-together is planned for the first day, with the succeeding days holding numerous pleasant events. Among these is a sightseeing trip to Canada, which will go by way of Ambassador Bridge and return by way of the tunnel under the Detroit River. The trip will include a visit to some of the famous gardens of Windsor, a shopping tour, and tea at the Prince Edward Hotel in Windsor.

The following day at the Detroit Yacht Club on beautiful Belle Isle, a luncheon and fashion show will be held, with latest styles shown by models from some of Detroit's better shops. A dinner and keno party are planned for the following evening at the Book-Cadillac Hotel.

One of the exceptional entertainment features planned for the women is a visit to world-famous Greenfield Village. Among the innumerable attractions of the village are a group of homes of various periods from the early 17th through the 19th century, each complete with furnishings of its period, and various small shops and handicraft industries of early American days, including an apothecary shop, several early jewelry shops, and a tintype studio. Prominent in the village sights is the reconstructed original of the Menlo Park Laboratory and associated buildings, which were transported from New Jersey, complete even to the red soil typical of the original site. A luncheon at Dearborn Inn will follow the visit to the village, and in the afternoon a visit will be made to the Edison Institute Museum.

The sports committee has made arrangements with the Glen Oaks Golf Club for the use of the course during the first four days of the convention. A full golfing program is planned, including the Mershon Match Play Tournament, the Lee Tournament, which is a two-day, 36-hole medal play on a handicap, and at least one Kicker's Handicap Tournament. Anyone who desires to play without entering a tournament is welcome to do so. Transportation will be provided to and from the course.

Though no golf tournaments are planned for the women, the course privileges and transportation will be arranged for those who desire to play.

The past record has indicated very little interest in tennis, therefore, for this reason and because of the difficulty of obtaining suitable tennis courts, no tennis tournaments are planned.

INSPECTION TRIPS

The various scheduled trips are so diversified as to satisfy every interest. One of the planned inspection trips with an unusually wide engineering coverage is the trip to the Chrysler Engineering Laboratories. Here, in a series of laboratories and test chambers, the Chrysler engineers check every detail of the parts which go to make up the finished automobile. Visitors will be conducted through the various testing laboratories to view the electric system tests, stress analysis, and fatigue tests, the checks made in the cold temperature chamber, which often has been pictured in advertisements, engine testing on latest type dynamometer units, and various materials testing and development, including rubber and plastics.

Also scheduled is a trip to the Ford Motor Company Rouge Plant at Dearborn, Mich., the world's largest industrial city. Grouped into a single unit covering 1,196 acres are blast furnaces, coke ovens, docks, assembly lines, machine and repair shops. Here are railroad and bus systems, the world's largest production foundry, a paper mill and a glass plant, power houses, and laboratories. More than 90,000 men and women are employed with a variety of skills and trades—seamstresses and sailors, carpenters and cooks, artists and accountants, metallurgists and machinists. Within the Rouge plant are more than 100 miles of railroad—one of the longest private railroads in the world. One and one-third miles of docks are needed to handle waterborne shipments, including upwards of 850,000 tons of ore and 2,078,000 tons of coal a season. Over 13,875,000 square feet of floor space, and 132 miles of conveyors are used in the Rouge Plant buildings. More than 538 million gallons of water are used in a day's operations, as well as enough gas for a city of 1,500,000 people. The ten open-hearth furnaces which provide steel for the rolling mill have a total capacity of over 1,800 tons per day.

Also prominent in the schedule of technical trips is the one to the Detroit plant of the United States Rubber Company on the Detroit River near scenic Belle Isle.

The principal product of this plant is automobile tires, and the visitor can view the various phases of manufacture from crude or synthetic rubber and cotton cords, rayon, or other fabrics all the way to the finished tire. Interesting manufacturing processes include the solutioning of cord or rayon fabric, the rubberizing of this fabric in calender trains, bias cutting and tire building operations, breaking down of crude or synthetic rubber in plasticators, compounding in Banbury mixers, and tuber and dual tuber operations forming tread and sidewall sections. Also evident is the continuous building of smaller size tires on "merry-go-rounds" and the mass vulcanizing of the daily quota, which present production schedules have set at approximately 30,000 units per day. Testing facilities allow the checking of any size tire, including landing tests for big airplane tires.

The recently completed expansion program added a number of modern electric drives, such as a synchronized rubber calender train, featuring a number of electronic and rotating regulator controls, new type rubber mills controlled by metal-clad vertical lift air circuit breakers, and new Banbury drives, including separately ventilated and cooled induction motors.

Of the scheduled inspection trips, the one which is planned to the Edison Institute Museum, although possibly ranking beneath the others in technical interest, will in all probability provide one of the highlights by virtue of the unusual group of exhibits which Mr. Henry Ford has spared no expense to collect. Under the three major divisions of agriculture, manufacture, and transportation, are shown the evolution and development of agricultural and household arts implements and equipment, replicas and collections of steam and electric power machinery from the earliest known types, numerous industries displays which utilize such power, and a complete exhibit of transportation equipment covering all forms of animal and powered carriers, and including development of bicycles, locomotives, automobiles, and airplanes. In addition to the major exhibits there are various handicraft shops and a museum collection of some 6,000 pieces of furniture, as well as musical instruments from earliest times to the present.

HOTEL ACCOMMODATIONS

The hotels committee has been fortunate in securing block reservations at a group of hotels, the names and rates of which are listed in the accompanying table. All are within a short distance of headquarters.

The critical status of room reservations makes it imperative that reservations be made immediately to avoid disappointment. All requests for reservations should be addressed to AIEE Summer Convention Hotels Committee, 1005 Stroh Building, Detroit 26, Mich. It is also essential that the time of arrival be given. Double occupancy should be used wherever possible.

Hotel	Rates	
	Single	Double
Book-Cadillac	$3.00 up	$5.00 up
Detroit Leland	$2.50 up	$4.00 up
Fort Shelby	$2.50 up	$4.00 up
Statler (headquarters)	$3.00 up	$4.50 up
Tuller	$2.00 up	$3.50 up

Mexico Section Participates in South West District Meeting

Re-establishing its program of District meetings and Student Branch conventions, the AIEE South West District met at the Plaza Hotel in San Antonio, Tex., April 16–18, 1946, the South Texas Section acting as host with the collaboration of the Houston Section. The total registration of 366 exceeded the committee's expectations by a substantial margin, and indicates a wide and healthy interest and participation in AIEE affairs in the South West. All Sections, Subsections, and Student Branches were represented, although there was insufficient time for the development of a complete Student program and full Student participation. Registration statistics are given in accompanying tabulations.

Analysis of Registration at San Antonio

Classification	South Texas Section	District 7*	Other Districts	Totals
Members	37	119	29	185
Enrolled Students	6	28		34
Men guests	21	36	11	68
Women guests	15	56	8	79
Totals	79	239	48	366

* Outside South Texas.

The Mexico Section was an active participant in the San Antonio meeting, and gave it a very practical flavor of international co-operation. Those present included: Basil Nikiforoff (M '20) *past chairman*, Mexico Section, and chief electrical engineer, Mexico Light and Power Company, Mexico, Federal District, Mexico; Bernardo E. Arias (M '28) *past chairman*, Mexico Section, and chief electrical engineer, National Railways of Mexico; Federico A. Nava (A '42) *past chairman*, Mexico Section, and commercial manager, Westinghouse Electric Distributing Company, Mexico; Alejandro Paez Urquidi (A '44) *past chairman*, Mexico Section, and head of the rate department, Cia. Impulsora de Empresas Electricas, Mexico; Eduardo Luque Diaz, assistant manager in charge of Industria Electrica de Mexico, and professor of electrical engineering, University of Mexico; Luis Mascott (M '44) regional engineer in the Mexican territory for the Westinghouse Electric International Company and professor, University of Mexico; Antonio Baca (A '36) *secretary* of the Mexico Section and manager, elevator department, Westinghouse Electric Distributing Company; Manuel Diaz Montes de Oca (A '44) private dealer in electrical devices in the city of Mexico; Jaime Gonzalez Gil (A '31) electrical technical advisor to the government of the state of Coahuila, Mexico; Raoul Ramirez, manager air conditioning department, Westinghouse Electric Distributing Company; and Oscar R. Enriquez (A '42) general director of electricity under the orders of the Secretary of National Economy, and head of the hydroelectric division, Comision Nacional de Irrigacion.

With the assignment of Mexico as an integral part of the South West District, by action of the board of directors, May 22, 1945, and activation of the Beaumont Section, June 27, 1945, the District now is comprised of 11 Sections, 2 Subsections and 15 Branches. The Sections now include Mexico, New Mexico–West Texas, South Texas, Beaumont, Houston, Kansas City, North Texas, Oklahoma City, St. Louis, Tulsa, and Wichita. The Subsections include Albuquerque and Panhandle. Student Branches include University of Arkansas, Fayetteville; Kansas State College, Manhattan; University of Kansas, Lawrence; Missouri School of Mines and Metallurgy, Rolla; University of Missouri, Columbia; New Mexico State College, State College; University of New Mexico, Albuquerque; Oklahoma Agricultural and Mechanical College, Stillwater; University of Oklahoma, Norman; Rice Institute, Houston; Southern Methodist University, Dallas; Texas Agricultural and Mechanical College, College Station; Texas Technological College, Lubbock; University of Texas, Austin; and Washington University, St. Louis.

In addition to the four technical papers previously abstracted in *Electrical Engineering*, 18 other technical topics were presented mostly in the form of informal talks or discussions, at 6 technical sessions. Supplementing these were three Student papers at the Student session, a series of general addresses at the opening general session, and a conference on Institute activities.

GENERAL SESSION

R. W. Warner, (F'39) AIEE vice-president for the South West District, presided at the opening general session, calling special attention to the participation of the Mexico Section and the presence of a large representation therefrom. O. R. Enriquez, chairman of the Mexico Section, responded with greetings from that Section, and a brief outline of its plans for the visit of President Wickenden, April 22.

Acting on behalf of Mayor G. B. Mauermann of San Antonio, Colonel W. B. Tuttle (M '30) chairman of the San Antonio Public Service Board, extended the city's official welcome and briefly outlined the evolutionary developments of electric power distribution and utilization in San Antonio. The San Antonio system is city-owned, having been taken over from the San Antonio Public Service Company in 1944.

Speaking on the assigned topic "The Institute Today," Secretary H. H. Henline presented a descriptive cross section of the Institute's organization and functional procedures, in accordance with the policies as established by the board of directors in the furtherance of the original and continuing basic objectives of the Institute: "The advancement of the theory and practice of electrical engineering and of the allied arts and sciences, and the maintenance of a high professional standing among its members." Mr. Henline traced the activities through which the Institute has grown through its 62 years of life, now comprising some 75 Sections, 24 Subsections, 75 technical groups, 125 Student Branches, and a total membership of 24,857 as of April 1, 1946. *Electrical Engineering* has a circulation currently in excess of 31,000. Now, 31 per cent of the total membership is in the Member and Fellow grades, as compared with 17 per cent in 1925. Mr. Henline touched briefly on some of the current problems and opportunities of the Institute, and laid especial emphasis upon the need for a greater flexibility in its technical organization and procedures, to enable it to meet the challenge of rapid growth and continuing changes in the ever-widening electrotechnical field.

"Tomorrow's Engineering Developments" were described by M. W. Smith (F '42) vice-president in charge of engineering for the Westinghouse Electric Corporation (see pages 197–201 of this issue).

Discussing "Engineering for Postwar Problems," A. S. Langsdorf (F '12) dean of engineering and architecture, Washington University, St. Louis, Mo., bluntly challenged the efficacy or desirability of some of the current trends in education, and called upon engineers in the teaching profession as well as those in commercial and industrial practice to give attention to the matter so that education could better serve its objective of fitting its recipients to take a constructive and productive place in a complex and highly technological civilization. Dean Langsdorf criticized the growing philosophy in American public schools that no student should fail; that all should "pass" regardless of capabilities or aptitudes. He called for more teaching of grammar in grammar schools, and more teaching of practical English, composition, and othersuchfundamentals in high schools. He called also for a sifting of college technical curricula, to eliminate the many existing duplications and repetitions, thus providing more time and opportunity for the broadening of the coverage of such curricula that is necessary in his opinion to fit engineering and other technical students to meet the requirements of rapidly expanding technology. He took special issue with the

Comparison of South West District Meeting Attendance

1946	**San Antonio, Tex.**	**366**
1943	Kansas City, Mo.	339
1941	St. Louis, Mo.	553
1939	Houston, Tex.	535
1936	Dallas, Tex.	533
1935	Oklahoma City, Okla.	571
1931	Kansas City, Mo.	411
1929	Dallas, Tex.	541
1928	St. Louis, Mo.	500
1927	Kansas City, Mo.	225

recurrent proposal further to dilute current engineering curricula by the substitution of 20 per cent of selected "cultural" subjects. Dean Langsdorf cited the cultural education of an engineer as a continuing process applicable differently to different individuals, and tossed the responsibility for such continuing education on the national engineering societies rather than on the colleges. Dean Langsdorf's address is scheduled for publication in an early issue of *Electrical Engineering*.

President Wickenden, responding to the chairman's request for remarks, reminded his listeners that "like it or not, the engineer and scientist of today finds himself very much at the center of the complex and rapidly moving problems of an atomic age." As an indication of the factors underlying current legislative trends, he pointed out that 125 years ago some 75 per cent of the people of the United States earned their living from their own property, whereas now only something like 15 per cent earn their living from their own property. Thus, has come about the trend from laws protecting property to the modern trend of legislation establishing labor rights, wage levels, and other aspects of social security. As for national wealth, Doctor Wickenden pointed out that the days of "windfall wealth" are approaching an end—the days of discovering and exploiting great mineral and oil deposits, for example. Doctor Wickenden stated that "tomorrow's prospecting or new developments of importance to national wealth will be done in the research laboratories, not in the great open spaces." He also stated that "the time has gone by when the engineer and scientist can consider that he has discharged his obligation to society by just the doing of an honest day's work on an assigned technical job; he must be imaginative and forward-looking; he must create."

EXECUTIVE COMMITTEES MEET

The District executive committee held a luncheon meeting Friday noon, April 18. Action on the next District meeting and Student Branch convention was held in abeyance, and referred to the 1946–47 committee.

The formation of technical groups within the various Sections, as a means of expanding the range of subject matter and the opportunity for individual participation in line with local conditions and interests, has been one of the most active projects of the District executive committee during the past year. The St. Louis Section reported that it had activated discussion groups on industrial power and on electronics, and planned to activate three more this next year. Houston reported two, one on electronics and one on industrial applications, and reported that more new membership applications had resulted from extension of technical group activities than from any other single source of activity. Tulsa reported discussion groups on electronics and on corrosion testing, with plans for two or three more next year. Kansas City reported three technical groups, one on professional matters, one on electronics, and one on industrial practices; some of these groups meet every two weeks, the interest is so active. Oklahoma City reported six: frequency modulation, electronics, transmission and distribution, a-c circuit analysis, rural electrification, and nuclear physics, with attendance averaging 10 or better. New Mexico–West Texas reported discussion groups on power and on electronics, with attendance ranging from 15 to 20; and also reported formation of the Albuquerque Subsection, with an active response from members in that territory. Wichita currently is surveying the various industries to ascertain subjects of interest. Beaumont, a brand-new Section, developed as an offshoot of the Houston Section, is actively planning technical groups. Mexico Section reported that it is planning to establish Subsections in Monterey, Chihuahua, and Saltillo. South Texas reported no technical groups as yet.

Student counselors and chairmen of Student Branches held a joint luncheon meeting Wednesday, April 17. Professor M. C. Hughes (F '43) head of the electrical engineering department, Agricultural and Mechanical College of Texas, and chairman of student counselors for the South West District presided. E. W. O'Brien (M '37) of Atlanta, Ga., chairman of the AIEE committee on Student Branches, was in attendance. He reported briefly on the plans for joint Student Branch organizations where such are advantageous, and laid special emphasis upon the reactivation of District Student Branch conferences, either separately or in connection with District meetings.

Action was taken by the counselors calling for definite plans to be made beginning at once for a Student conference next year, to be held in connection with the District meeting if a District meeting is held, and to be held separately otherwise. Action also was taken electing officers of the District Student Branch counselors for the administrative year 1946–47 as follows: *District Student Branch chairman*, Professor C. L. Farrar (M '40) of the University of Oklahoma; *District counselor secretary*, M. V. McEnany (A '43) of Rice Institute.

STUDENT TECHNICAL SESSION

A student technical session, under the chairmanship of Professor W. F. Helwig, (M '31) counselor of the Student Branch at Texas Technological College, attracted an attendance of some 65 persons including many engineers in addition to the students. Four student papers were presented, as follows:

1. "A New Tool for Frequency Modulation," **Vernon Holman**, Kansas State College Branch.
2. "Principles of Grounding," **G. D. Spradling**, University of Missouri Branch.
3. "Residential Heating by Electricity," **C. D. Montgomery**, Southern Methodist University Branch.
4. "Applications of Selsyn Equipment," **Paul L. Harton**, Southern Methodist University Branch.

ENTERTAINMENT

A general trip to Randolph Field, the United States Army Air Forces "West Point of the air," some 17 miles north of San Antonio, was one of the two major general entertainment features for men and women. About 120 persons made this trip. The biggest feature on the entertainment program was the banquet held at the Plaza Hotel, Wednesday evening, April 17, and attended by 308 persons, the capacity of the ballroom. A musical show featuring Mexican music, singers, and dancers, won the noisy approval of the guests. President Wickenden brought the affair to a close with a brief, entertaining, and stimulating address.

A full program of entertainment features for women guests included, in addition to the features mentioned in the foregoing paragraph, a sight-seeing tour to the many points of historic and scenic interest in San Antonio and environs, a dinner at the San Antonio country club, and a bridge party at the Plaza Hotel. The women's dinner at the country club paralleled the stag smoker and informal social hour at the Plaza Hotel the evening of the first day.

Future AIEE Meetings

Summer Convention
Detroit, Mich., June 24–28, 1946

Pacific Coast Convention
Seattle, Wash., August 27–30, 1946

Great Lakes District Meeting
Fort Wayne, Ind., September 25–27, 1946

Conference on Institute Activities Held at South West District Meeting

In furtherance of its current program of investigating AIEE affairs for the purpose of determining ways and means of improving them, the AIEE committee on planning and co-ordination sponsored a conference at San Antonio during the District meeting. Chairman of the conference session, and representative of the committee, was T. G. LeClair, (F' 40) chairman of the professional activities subcommittee.

As the basis for discussion, reprints of the subcommittee's progress report entitled "Organization of the Engineering Profession" (*EE, Apr '46, pp 169–73*) had been widely distributed the day before the meeting; also, current progress reports prepared by the professional activities subcommittee and by the technical activities subcommittee of the committee on planning and co-ordination (*pp 222–4*) were

read to the conference group. To facilitate the committee's further study, questionnaires were distributed for execution by those present.

Representatives of the various Sections and other groups in the District were called upon for comment and discussion, and in addition to this there was some discussion and questioning from the floor. The discussion may be summarized briefly as indicating clearly a desire for (a) continuation and expansion of the Institute's program of technical activities; (b) appropriate active parallel participation in the so-called "professional," or nontechnical, fields affecting and affected by engineers, by appropriate collaboration with other engineering societies. In terms of the "plans" of the subcommittee's report, "Plan B" was favored by most commentators, but strong support also was expressed for appropriate utilization of the local-council idea indicated in "Plan C." The question of the registration and licensing of professional engineers was touched upon in some way or other by most of the commentators.

In accordance with the program as previously arranged, Elgin B. Robertson (F '45) of Dallas, past president of the Texas Society of Professional Engineers, presented a summarizing discussion to conclude the conference. Mr. Robertson, long active in the National Society of Professional Engineers, also has been active over a great many years in AIEE affairs, and currently is District vice-chairman of the AIEE membership committee.

Mr. Robertson, touching upon the various ideas brought forth in the conference, dwelt particularly upon the relationship between the field of engineering activity represented by the National Society of Professional Engineers and the fields of activity represented by the AIEE and other national engineering and technical societies. On the basis of his own varied experience and active participation, he pointed out strongly that both phases of engineering activity are essential, and that neither should be promoted or developed at the expense of the other. In Mr. Robertson's stated opinions, it is not only possible but logical and desirable that an individual engineer should divide his activities between his technical societies and his professional society, in accordance with his interests.

In defense of diverse technical societies, Mr. Robertson asserted that in his opinion no single technical society can be all inclusive and function adequately in the several technical fields. Conversely, however, he stated his firm conviction that a professional society such as the National Society of Professional Engineers could perform successfully on an all-inclusive basis embracing the general considerations which are common to all engineers regardless of technical specialty. Identifying the foregoing comments as representing his point of view as past president of the Texas Society of Professional Engineers, Mr. Robertson stated that for his comments as an AIEE member and as District vice-chairman of the membership committee, he would read a letter just received from Lawrence F. Howard, chairman of the AIEE membership committee, which represented his views, also. The essential substance of Mr. Howard's communication is given in the following paragraphs.

"... it is the job of the membership committee to be ready at all times to assist in acquainting qualified persons with the advantages of becoming a member of the American Institute of Electrical Engineers. These advantages are many and stem from the fact that the AIEE is *the* organization representing the electrical engineering profession which has membership in all parts of the Western Hemisphere and abroad. The degree of accomplishment of the committee is measured particularly in the last two years by an increase in membership from about 21,400 to an expected total of 25,000 or more in May of this year. The strength of the Institute is emphasized further by the fact that 2,500 members who had an 'inactive' status during the war period are now voluntarily requesting active status again as their war service terminates. Some 600 have been reinstated to active membership in the last few months and the requests are coming in rapidly from others each day. Another significant fact is that which pertains to delinquents. This year the number of delinquents (those one year in arrears in dues) is approximately one-half of the number one year ago. It is the lowest for a great many years in the history of the Institute. It is significant also that the Student membership as of January 1946 was approximately 4,000 and that this number was only 43 smaller than in January 1945. The number of members-for-life are 1,170, of which number 113 still choose to pay dues. There are 51 Life Members. The number of applications continues to run ten per cent ahead of last year. For the first time there are now more members of Member grade than Associates of more than six years standing.

"There seems to be no sign at present which indicates the Institute should not continue to grow in numbers and influence correspondingly. It is the largest by far of the four Founder Societies. It is unique in its field of opportunity to the individual electrical engineer and for service to humanity by virtue of the fact that the development in the future will be so closely allied with electronic applications.

"Under such conditions and considering the peculiarities of the present economic situation, it is only natural that questions relative to the organization of the Institute should arise. Certainly, however, no disintegration or crumbling of the Institute is in view as a result. On the contrary, it seems quite clear that an organization which has served so faithfully and well in the past is in the best position to meet the present and future challenge of the electrical engineering field.

"Any modifications other than possibly the establishment of new committees and the broadening of the responsibilities of the present committees are not clear as yet from a membership committee activity standpoint. Certainly our officers and the board of directors are aware of any matters in this connection and are guiding the course of the Institute ably with the benefit of constructive suggestions from the Sections. For example, steps along those lines have been taken and the results of a committee study on the question of 'collective bargaining' have been made available. According to the data at hand, more information on that subject is to be sent to each member of the Institute. The activities of other committees should develop some other constructive thoughts. There appears as yet no need for the membership committee to change its policy or to lessen its enthusiasm in carrying the benefits of membership in the Institute to all qualified persons....

"Membership work cuts across every activity of the Institute; or, to put it in another way, the activities of the Institute's Sections can cause persons to be enthused toward becoming members or materially dampen any enthusiasm present. The membership committee and members of the Institute, therefore, can be instrumental in obtaining new members but the membership committee alone cannot keep them interested if other activities of the Institute do not give the members attractive programs and opportunities to keep the interest alive. The Sections committee of the Institute has realized this fact and is more than usually active in stimulating the functioning of the Sections.

"The Institute is an organization of individuals working toward the advancement of the theory and practice of electrical engineering and the allied arts and sciences, the maintenance of a high professional standing among its members and the development of the individual engineer...."

The various comments and questionnaires collected from the San Antonio conference will be studied by the committee on planning and co-ordination, along with similar information which the committee is planning to gather at other similar meetings and conferences.

Annual Meeting

The annual meeting of the American Institute of Electrical Engineers will be held at the Hotel Statler, Detroit, Mich., at 10 a.m. Monday, June 26, 1946.

At this meeting, the annual report of the board of directors and the report of the committee of tellers on the ballot cast for the election of officers will be presented. The Lamme Medal will be presented to David C. Prince (F '26), and awards of Institute prizes will be announced.

Such other business, if any, as properly may come before the annual meeting may be considered.

(*Signed*) H. H. HENLINE
Secretary

AIEE Endorses Model Law for Registration of Engineers

At its January meeting the AIEE board of directors adopted a resolution declaring "that the AIEE recognizes the registration of engineers as a continuing practice and the 'Model Law for the Registration of Professional Engineers and Land Surveyors' as adopted in 1943 and amended in 1945, as the widely accepted basis of its administration, and that the Institute endorses these procedures as well established." In line with this endorsement, the board approved a recommendation that the special AIEE committee on registration of engineers be replaced by a standing committee.

The first such model law indorsed by a number of engineering societies was drafted in 1932. Revisions were incorporated in 1937 and 1943. Organizations which have endorsed this latest amended law are: the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Association of Engineers, the American Institute of Consulting Engineers, the National Society of Professional Engineers, the National Council of State Boards of Engineering Examiners, the American Society of Heating and Ventilating Engineers, and the American Institute of Mining and Metallurgical Engineers. The text of the law as revised in 1943 follows, with the amendments agreed upon in August 1945 appearing in italic type.

Text of Model Law

TITLE

An Act to regulate the practices of engineering and land surveying; providing for the registration of qualified persons as professional engineers and land surveyors, and providing for the certification of engineers-in-training; defining the terms "engineer," "professional engineer," "engineer-in-training," "practice of engineering," "land surveyor" and "practice of land surveying"; creating a state board of registration for professional engineers and land surveyors and providing for the appointment of its members; fixing the term of the Board and defining its powers and duties; setting forth the minimum qualifications and other requirements for registration; establishing fees with expiration and renewal requirements; imposing certain duties upon the State and political subdivisions thereof in connection with public work, and providing for the enforcement of this Act and penalties for its violation.

GENERAL PROVISIONS

Section 1. Be it enacted by the General Assembly of the State of .... that in order to safeguard life, health, and property, and to promote the public welfare, any person in either public or private capacity practicing or offering to practice engineering or land surveying,[1] shall hereafter be required to submit evidence that he is qualified so to practice and shall be registered as hereinafter provided; and it shall be unlawful for any person to practice or to offer to practice in this State, engineering or land surveying, as defined in the provisions of this Act, or to use in connection with his name or otherwise assume, use, or advertise any title or description tending to convey the impression that he is a professional engineer or a land surveyor, unless such person has been duly registered under the provisions of this Act.

[1] Land surveying does not involve matters that would ordinarily jeopardize life and health, but property rights are vitally affected by land surveying, and many states have deemed it essential to place restrictions and safeguards about its practice. Surveying is a function of engineering, but land surveying deals with land measurements involving property rights.

DEFINITION

Section 2. **The term engineer** as used in this Act shall mean a professional engineer as hereinafter defined.

The term "professional engineer" *within the meaning and intent of this Act shall mean a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to practice engineering as hereinafter defined, as attested by his legal registration as a professional engineer.*

The term engineer-in-training *as used in this Act shall mean a candidate for registration as a professional engineer who is a graduate in an approved engineering curriculum of four years or more from a school or college approved by the Board as of satisfactory standing, or who has had four years or more of experience in engineering work of a character satisfactory to the Board; and who, in addition, has successfully passed the examination in the fundamental engineering subjects prior to completion of the requisite years of experience in engineering work, as provided in Section 14 of this Act, and who shall have received from the Board, as hereinafter defined, a certificate stating that he has successfully passed this portion of the professional examinations.*

The term engineering as used in this Act shall mean engineering as hereinafter defined.

The term "practice of engineering" *within the meaning and intent of this Act shall mean any professional service or creative work requiring engineering education, training, and experience and the application of special knowledge of the mathematical, physical and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design, and supervision of construction for the purpose of assuring compliance with specifications and design, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works or projects.*

A person shall be construed to practice or offer to practice engineering, within the meaning and intent of this Act, who practices any branch of the profession of engineering; or who, by verbal claim, sign, advertisement, letterhead, card, or in any other way represents himself to be a professional engineer, or through the use of some other title implies that he is a professional engineer; or who holds himself out as able to perform, or who does perform, any engineering service or work or any other professional service designated by the practitioner or recognized by educational authorities as engineering.

The practice of engineering shall not include the work ordinarily performed by persons who operate or maintain machinery or equipment.

The term land surveyor as used in this Act shall mean a person who engages in the practice of land surveying as hereinafter defined.

The practice of land surveying within the meaning and intent of this Act includes surveying of areas for their correct determination and description and for conveyancing, or for the establishment or re-establishment of land boundaries and the plotting of lands and subdivisions thereof.

The term "Board" as used in this Act shall mean the State Board of Registration for Professional Engineers and Land Surveyors, provided for by this Act.

BOARD

Section 3. A State Board of Registration for Professional Engineers and Land Surveyors is hereby created whose duty it shall be to administer the provisions of this Act. The Board shall consist of five professional engineers, who shall be appointed by the Governor from among nominees recommended by the representative engineering societies in the State and shall have the qualifications required by Section 4. The members of the first Board shall be appointed within ninety days after the passage of this Act, to serve for the following terms: One member for one year, one member for two years, one member for three years, one member for four years, and one member for five years, from the date of their appointment, or until their successors are duly appointed and qualified. Every member of the Board shall receive a certificate of his appointment from the Governor and before beginning his term of office shall file with the Secretary of State his written oath or affirmation for the faithful discharge of his official duty. Each member of the Board first appointed hereunder shall receive a certificate of registration under this Act from said Board. On the expiration of the term of any member, the Governor shall in the manner hereinbefore provided appoint for a term of five years a registered professional engineer, having the qualifications required by Section 4, to take the place of the member whose term on said Board is about to expire. Each member shall hold office until the expiration of the term for which such member is appointed or until a successor shall have been duly appointed and shall have qualified.

Section 4. Each member of the Board shall be a citizen of the United States and a resident of this State, and shall have been engaged in the practice of the profession of engineering for at least twelve years, and shall have been in responsible charge of important engineering work for at least five years. Responsible charge of engineering teaching may be construed as responsible charge of important engineering work.

Section 5. Each member of the Board shall receive the sum of .... dollars ($.....) per diem when actually attending to the work of the Board or any of its committees and for the time spent in necessary travel; and, in addition thereto, shall be reimbursed for all actual traveling, incidental, and clerical expenses necessarily incurred in carrying out the provisions of this Act.[5]

Section 6. The Governor may remove any member of the Board for misconduct, incompetency, neglect of duty, or for any other sufficient cause. Vacancies in the membership of the Board shall be filled for the unexpired term by appointment by the Governor as provided in Section 3.

Section 7. The Board shall hold a meeting within thirty days after its members are first appointed, and thereafter shall hold at least...... regular meetings each year. Special meetings shall be held at such time as the by-laws of the Board may provide. Notice of all meetings shall be given in such manner as the by-laws may provide. The Board shall elect or appoint annually the following officers:[7] A Chairman, a Vice-Chairman, and a Secretary. A Quorum of the Board shall consist of not less than three members.

Section 8. The Board shall have the power to adopt and amend all by-laws and rules of procedure, not inconsistent with the Constitution and Laws of this State, which may be reasonably necessary for the proper performance of its duties and the regulations of the proceedings before it. The Board shall adopt and have an official seal.

In carrying into effect the provisions of this Act, the Board, under the hand of its Chairman and the seal of the Board, may subpoena witnesses and compel their attendance, and also may require the production of books, papers, documents, etc., in a case involving the revocation of registration or practicing or offering to practice without registration. Any member of the Board may administer oaths or affirmations to witnesses appearing before the Board. If any person shall refuse to obey any subpoena so issued, or shall refuse to testify or produce any books, papers, or documents, the Board may present its petition to such authority[8] as may have jurisdiction, setting forth the facts, and thereupon such authority shall, in a proper case, issue its subpoena to such person, requiring his attendance before such authority and there to testify or to produce such books, papers, and documents, as may be deemed necessary and pertinent by the Board. Any person failing or refusing to obey the subpoena or order of the said authority may be proceeded against in the same manner as for refusal to obey any other subpoena or order of the authority.

RECEIPTS AND DISBURSEMENTS

Section 9. The Secretary of the Board shall receive and account for all moneys derived under the provisions of this Act, and shall pay the same monthly to the

[5] The per diem allowance of members of the Board is not indicated nor is it intended to be fixed as a commensurate compensation for the services to be rendered. High grade professional men are expected to serve as a matter of good citizenship.

[7] It is deemed advisable to have a member of the Board fill the office of Secretary, but as provided in Section 9, the Board may appoint an assistant secretary, executive secretary, treasurer, or other officer, not a member of the Board, to whom clerical and administrative duties may be assigned.

[8] "Authority" may be replaced by the designation of the proper Court or other suitable judicial unit.

State Treasurer, who shall keep such moneys in a separate fund to be known as the "Professional Engineers' Fund." Such fund shall be kept separate and apart from all other moneys in the Treasury, and shall be paid out only by ....[9] All moneys in the "Professional Engineers' Fund" are hereby specifically appropriated for the use of the Board. The Secretary of the Board shall give a surety bond to the State in such sum as the Board may determine. The premium on said bond shall be regarded as a proper and necessary expense of the Board, and shall be paid out of the "Professional Engineers' Fund." The Secretary of the Board shall receive such salary as the Board shall determine in addition to the compensation and expenses provided for in Section 5. The Board may employ such clerical or other assistants as are necessary for the proper performance of its work, and may make expenditures of this fund for any purpose which in the opinion of the Board is reasonably necessary for the proper performance of its duties under this Act, including the expenses of the Board's delegates to annual conventions of, and membership dues to, the National Council of State Boards of Engineering Examiners. Under no circumstances shall the total amount of warrants issued by ....[9a] in payment of the expenses and compensation provided for in this Act exceed the amount of the examination and registration fees collected as herein provided.

RECORDS AND REPORTS

Section 10. The Board shall keep a record of its proceedings and a register of all applications for registration, which register shall show (*a*) the name, age, and residence of each applicant; (*b*) the date of the application; (*c*) the place of business of such applicant; (*d*) his educational and other qualifications; (*e*) whether or not an examination was required; (*f*) whether the applicant was rejected; (*g*) whether a certificate of registration was granted; (*h*) the date of the action of the Board; and (*i*) such other information as may be deemed necessary by the Board.

The records of the Board shall be *prima facie* evidence of the proceedings of the Board set forth therein, and a transcript thereof, duly certified by the Secretary of the Board under seal, shall be admissible in evidence with the same force and effect as if the original were produced.

Annually, as of .... [insert date], the Board shall submit to the Governor a report of its transactions of the preceding year, and shall also transmit to him a complete statement of the receipts and expenditures of the Board, attested by affidavits of its Chairman and its Secretary.

ROSTER

Section 11. A roster showing the names and places of business of all registered professional engineers and all registered land surveyors shall be published by the Secretary of the Board during the month of .... of each year. Copies of this roster shall be mailed to each person so registered, placed on file with the Secretary of State, and furnished to the public upon request.[11]

GENERAL REQUIREMENTS FOR REGISTRATION

Section 12. The following shall be considered as minimum evidence satisfactory to the Board that the applicant is qualified for registration as a professional engineer, engineer-n-training, or land surveyor, respectively; to wit:

(1) As a professional engineer:

a. Graduation Plus Experience. Graduation in an approved engineering curriculum of four years or more from a school or college approved by the Board as of satisfactory standing; and a specific record of an additional four years or more of experience in engineering work of a character satisfactory to the Board, and indicating that the applicant is competent to practice engineering (in counting years of experience, the Board at its discretion may give credit, not in excess of one year, for satisfactory graduate study in engineering), provided that in a case where the evidence presented in the application does not appear to the Board conclusive nor warranting the issuing of a certificate of registration, the applicant may be required to present further evidence for the consideration of the Board, and may also be required to pass an oral or written examination, or both, as the Board may determine; or

b. Experience Plus Examination. *A specific record of eight years or more of experience in engineering work of a character satisfactory to the Board and indicating that the applicant is competent to practice engineering; and successfully passing a written or written and oral, examination designed to show knowledge and skill approximating that attained through graduation in an approved four-year engineering curriculum; or*

c. Engineers of Long Established Practice. A specific record of twelve years or more of lawful practice in engineering work of a character satisfactory to the Board and indicating that the applicant is qualified to design or to supervise construction of engineering works and provided applicant is not less than thirty-five years of age.

(2) As an engineer-in-training:

a. Graduation Plus Examination. *Graduation in an accredited engineering curriculum of four scholastic years or more from a school or college approved by the Board as of satisfactory standing, and successfully passing a written examination in the basic engineering subjects; or*

b. Experience Plus Examination. *A specific record of four years or more of experience in engineering work of a character satisfactory to the Board; and successfully passing the Board's written examination in the basic engineering subjects.*

a. Graduation Plus Experience. Graduation from a school or college approved by the Board as of satisfactory standing, including the completion of an approved course in surveying; and an additional two years or more of experience in land surveying work of a character satisfactory to the Board and indicating that the applicant is competent to practice land surveying; or

b. Experience Plus Examination. *A specific record of six years or more of experience in land surveying work of a character satisfactory to the Board and indicating that the applicant is competent to practice land surveying; and successfully passing a written, or written and oral, examination in surveying prescribed by the Board; or*

c. Long Established Practice. A specific record of ten years or more of lawful practice in land surveying work of a character satisfactory to the Board and provided applicant is not less than thirty years of age.

CHARACTER

No person shall be eligible for registration as a professional engineer, engineer-in-training, or land surveyor, who is not of good character and reputation.

TEACHING CREDITS

In considering the qualifications of applicants, engineering teaching may be construed as engineering experience.

EDUCATION CREDITS

The satisfactory completion of each year of an approved curriculum in engineering in a school or college approved by the Board as of satisfactory standing, without graduation, shall be considered as equivalent to a year of experience in Section 12 (1)*b* and (2)*b*. Graduation in a curriculum other than engineering from a college or university of recognized standing may be considered as equivalent to two years of experience in Section 12 (1)*b* and (2)*b*; provided, however, that no applicant shall receive credit for more than four years of experience because of undergraduate educational qualifications.

WORK AS CONTRACTOR

The mere execution, as a contractor, of work designed by a professional engineer, or the supervision of the construction of such work as a foreman or superintendent shall not be deemed to be practiced in engineering.

NON-PRACTICING APPLICANTS

Any person having the necessary qualifications prescribed in this Act to entitle him to registration shall be eligible for such registration although he may not be practicing his profession at the time of making his application.

APPLICATIONS AND REGISTRATION FEES

Section 13. Applications for registration shall be on forms prescribed and furnished by the Board, shall contain statements made under oath, showing the applicant's education and detail summary of his technical work, and shall contain not less than five references, of whom three or more shall be engineers having personal knowledge of his engineering experience.

The registration fee for professional engineers shall be twenty-five dollars ($25.00), fifteen dollars ($15.00) of which shall accompany application, the remaining ten dollars ($10.00) to be paid upon issuance of certificate. *The fee for engineer-in-training shall be ten dollars ($10.00), which shall accompany the application and shall include the cost of examination and issuance of certificate. When registration as a professional engineer is completed by an engineer-in-training, an additional fee of fifteen dollars ($15.00) shall be paid before issuance of certificate as professional engineer.* When a certificate of qualification issued by the National Bureau of Engineering Registration is accepted as evidence of qualification, the total fee for registration as professional engineer shall be ten dollars ($10.00).

The registration fee for land surveyors shall be fifteen dollars ($15.00), which shall accompany application.

Should the Board deny the issuance of a certificate of registration to any applicant the initial fee deposited shall be retained as an application fee.[13]

EXAMINATIONS

Section 14. When oral or written examinations are required, they shall be held at such time and place as the Board shall determine. If examinations are required on fundamental engineering subjects (such as are ordinarily given in college curricula) the applicant shall be permitted to take this part of the professional examination prior to his completion of the requisite years of experience in engineering work, and satisfactory passage of this portion of the professional examination by the applicant shall constitute a credit for a period of ten years. The Board shall issue to each applicant upon successfully passing the examination in fundamental engineering subjects a certificate stating that he has passed the examination and that his name has been recorded as an engineer-in-training.

The scope of the examinations and the methods of procedure shall be prescribed by the Board with special reference to the applicant's ability to design and supervise engineering works so as to insure the safety of life, health, and property. Examinations shall be given for the purpose of determining the qualifications of applicants for registration separately in engineering and in land surveying. A candidate failing on examination may apply for re-examination at the expiration of six months and will be re-examined without payment of additional fee. Subsequent examination will be granted upon payment of a fee to be determined by the Board.

CERTIFICATES—SEALS

Section 15. The Board shall issue a certificate of registration upon payment of registration fee as provided for in this Act, to any applicant who, in the opinion of the Board, has satisfactorily met all the requirements of this Act. In case of a registered engineer, the certificate shall authorize the practice of "engineering," and in the case of a registered land surveyor, the certificate shall authorize the practice of "land surveying."

In case of engineer-in-training, the certificate shall state that the applicant has successfully passed the examination in fundamental engineering subjects required by the Board and has been enrolled as an "engineer-in-training." Certificates of registration shall show the full name of the registrant, shall have a serial number, and shall be signed by the Chairman and the Secretary of the Board under seal of the Board.

The issuance of a certificate of registration by this Board shall be *prima facie* evidence that the person named therein is entitled to all the rights and privileges of a registered professional engineer, or of a regis-

[9] Insert title of proper State official, and method of authentication and payment.

[9a] Insert title of proper State official.

[11] It is desirable that copies of the annual rosters be made available to county authorities and to the authorities of the principal cities in the State, for record.

[12] The standard of qualification is set high for two reasons: The public welfare will be better promoted by maturer competency; and the prestige attaching to the term "Registered" will be more significant for the professional men themselves. In requiring the younger, less experienced men to serve somewhat longer as assistants or understudies to older men, no hardship is imposed which will not be compensated by the fuller return in recognition when registration is achieved.

[13] It may be advisable in some cases to grant the Board authority, with the approval of the Governor, to increase or decrease the fees for certificates and renewals within certain defined limits, in order to keep the Board self-sustaining, and to meet any objection raised that the passage of the Registration Act would tend to increase taxes.

tered land surveyor, while the said certificate remains unrevoked or unexpired.

Each registrant hereunder shall upon registration obtain a seal of the design authorized by the Board, bearing the registrant's name and the legend, "Registered Professional Engineer," or "Registered Land Surveyor." Plans, specifications, plats, and reports prepared by a registrant shall be stamped with the said seal when filed with public authorities, during the life of the registrant's certificate, but it shall be unlawful for any one to stamp or seal any documents with said seal after the certificate of the registrant named thereon has expired or has been revoked, unless said certificate shall have been renewed or reissued.[15]

EXPIRATIONS AND RENEWALS

Section 16. Certificates of registration shall expire on the last day of the month of .... following their issuance of renewal and shall become invalid on that date unless renewed. It shall be the duty of the Secretary of the Board to notify every person registered under this Act, of the date of the expiration of his certificate and the amount of the fee that shall be required for its renewal for one year; such notice shall be mailed at least one month in advance of the date of the expiration of said certificate. Renewal may be effected at any time during the month of........... by the payment of a fee of ...... dollars ($......).[16] The failure on the part of any registrant to renew his certificate annually in the month of .... as required above shall not deprive such person of the right of renewal, but the fee to be paid for the renewal of a certificate after the month of.............shall be increased ten per cent for each month or fraction of a month that payment of renewal is delayed; provided, however, that the maximum fee for delayed renewal shall not exceed twice the normal renewal fee.

PRACTITIONERS AT TIME ACT BECAME EFFECTIVE

Section 17. At any time within one year after this Act becomes effective, upon due application therefor and the payment of the registration fee of fifteen dollars ($15.00) for professional engineers, or ten dollars ($10.00) for land surveyors, the Board shall issue a certificate of registration, without oral or written examination, to any professional engineer or land surveyor who shall submit evidence under oath satisfactory to the Board that he is of good character, has been a resident of the State of..................for at least one year immediately preceding the date of his application, and was practicing engineering if an engineer, or land surveying if a surveyor, at the time this Act became effective, and has performed work of a character satisfactory to the Board.

After this Act shall have been in effect one year, the Board shall issue certificates of registration only as provided for in Section 12 or Section 19 thereof.

PUBLIC WORK

Section 18. After the first day of................, one thousand nine hundred and ...., it shall be unlawful for this State, or for any of its political subdivisions, such as a county, city, town, township, or borough to engage in the construction of any public work involving engineering, unless the plans and specifications and estimates have been prepared by, and the construction executed under the direct supervision of, a registered professional engineer; provided, that nothing in this Section shall be held to apply to any public work wherein the expenditure for the complete project of which the work is a part does not exceed two thousand dollars ($2,000.00).

INTERSTATE REGISTRATION

Section 19. The Board may, upon application therefor, and the payment of a fee of ten dollars ($10.00), issue a Certificate of Registration as a Professional Engineer to any person who holds a Certificate of Qualification of Registration issued to him by proper authority of the National Council of State Boards of Engineering Examiners, or of the National Bureau of Engineering Registration, or of any State or Territory or Possession of the United States, or of any Country, provided that the applicant's qualifications meet the requirements of this Act and the rules established by the Board.

REVOCATIONS

Section 20. The Board shall have the power to revoke the certificate of registration of any registrant who is found guilty of:

(*a*) The practice of any fraud or deceit in obtaining a certificate of registration;

(*b*) Any gross negligence, incompetency, or misconduct in the practice of engineering or land surveying as a registered professional engineer or land surveyor.

Any person may prefer charges of fraud, deceit, gross negligence, incompetency, or misconduct against any registrant. Such charges shall be in writing, and shall be sworn to by the person making them and shall be filed with the Secretary of the Board.

All charges, unless dismissed by the Board as unfounded or trivial, shall be heard by the Board within three months after the date on which they shall have been preferred.

The time and place for said hearing shall be fixed by the Board, and a copy of the charges, together with a notice of the time and place of hearing, shall be personally served on or mailed to the last known address of such registrant, at least thirty days before the date fixed for the hearing. At any hearing, the accused registrant shall have the right to appear personally and by counsel, to cross-examine witnesses appearing against him, and to produce evidence and witnesses in his own defense.

If, after such hearing, three or more members of the Board vote in favor of finding the accused guilty, the Board shall revoke the certificate of registration of such registered professional engineer or land surveyor.

REISSUANCE OF CERTIFICATES

The Board, for reasons it may deem sufficient, may reissue a certificate of registration to any person whose certificate has been revoked, providing three or more members of the Board vote in favor of such reissuance. A new certificate of registration, to replace any certificate revoked, lost, destroyed, or mutilated, may be issued, subject to the rules of the Board, and a charge of three dollars ($3.00) shall be made for such issuance.

APPEALS

Any person who shall feel aggrieved by any action of the Board in denying or revoking his certificate of registration may appeal therefrom to the..........[20] and, after full hearing, said Court shall make such decree sustaining or reversing the action of the Board as to it may seem just and proper.

VIOLATIONS AND PENALTIES

Section 21. Any person who shall practice, or offer to practice, engineering or land surveying in this State without being registered in accordance with the provisions of this Act, or any person presenting or attempting to use as his own the certificate of registration or the seal of another, or any person who shall give any false or forged evidence of any kind to the Board or to any member thereof in obtaining a certificate of registration, or any person who shall falsely impersonate any other registrant of like or different name, or any person who shall attempt to use an expired or revoked certificate of registration, or any person who shall violate any of the provisions of this Act, shall be guilty of a misdemeanor, and shall, upon conviction, be sentenced to pay a fine of not less than one hundred dollars ($100.00), nor more than five hundred dollars ($500.00), or suffer imprisonment for a period not exceeding three months, or both.

It shall be the duty of all duly constituted officers of the law of this State, or any political subdivision thereof, to enforce the provisions of this Act and to prosecute any persons violating same. The Attorney General of the State or his assistant shall act as legal adviser of the Board and render such legal assistance as may be necessary in carrying out the provisions of this Act.

SAVING CLAUSE

Section 22. This Act shall not be construed to prevent or to affect:

(*a*) **The practice of any other** legally recognized profession or trade; or

(*b*) **The practice of a person not a resident of** and having no established place of business in this State, practicing or offering to practice herein the profession of engineering or land surveying, when such practice does not exceed in the aggregate more than thirty days in any calendar year; provided, such person is legally qualified by registration to practice the said profession in his own State or Country in which the requirements and qualifications for obtaining a certificate of registration are not lower than those specified in this Act; or

(*c*) **The practice of a person not a resident** of and having no established place of business in this State, or **who has recently become a resident** thereof, practicing or offering to practice herein for more than thirty days in any calendar year the profession of engineering or land surveying, if he shall have filed with the Board an application for a certificate of registration and shall have paid the fee required by this Act; provided, that such a person is legally qualified by registration to practice said profession in his own State or Country in which the requirements and qualifications for obtaining a certificate of registration are not lower than those specified in this Act. Such practice shall continue only for such time as the Board requires for the consideration of the application for registration; or

(*d*) **The work of an employee or a subordinate** of a person holding a certificate of registration under this Act, or an employee of a person practicing lawfully under Paragraphs (*b*) or (*c*) of this Section; provided such work does not include final designs or decisions and is done under the direct responsibility, checking, and supervision of a person holding a certificate of registration under this Act or a person practicing lawfully under Paragraphs (*b*) or (*c*) of this Section; or

(*e*) **The practice of officers and employees of the Government** of the United States while engaged within this State in the practice of the profession of engineering or land surveying, for said Government.

INVALID SECTIONS

Section 23. If any Section or Sections of this Act shall be declared unconstitutional or invalid, this shall not invalidate any other Sections of this Act.

REPEAL OF CONFLICTING LEGISLATION

Section 24. All laws or parts of laws in conflict with the provisions of this Act shall be, and the same are hereby, repealed.

[15] It is suggested that the Board regulate the exact method of fulfilling the requirement that plans, specifications, plats, and reports shall be stamped. For example, the Board may rule that every sheet be stamped; or that the title or first sheet only need be stamped; or that only contract documents, or documents of record be stamped; etc.

[16] In States where registrants are few, the annual renewal fee may be $5, but in larger States $1 may be sufficient.

[20] Insert name of proper Court.

Planning Committee Releases Progress Reports

As of March 27, 1946, the following interim reports were received by the AIEE committee on planning and co-ordination and released by Chairman James F. Fairman for publication. These reports were presented by Mr. Fairman to the April 10 meeting of the executive committee of the board of directors at headquarters in New York, N. Y.

SUBCOMMITTEE ON PROFESSIONAL ACTIVITIES

The following report was prepared by T. G. LeClair (F '40) chairman of the professional activities subcommittee.

Change Status of Special Committee on Registration of Engineers. A recommendation to replace the present special committee by a standing committee was approved by the committee on planning and co-ordination and by the executive committee on December 11, 1945. The subcommittee, at the request of the board of directors, prepared a draft of the "scope and duties" of the proposed standing committee for incorporation in the bylaws. This draft was approved by the committee on planning and co-ordination and submitted to the board. (Editor's Note: Proposed bylaw revision reviewed by executive committee at April

10, 1946, meeting and approved in principle and referred to committee on constitution and bylaws.)

Recommendation to Approve and Aid Formation of Joint Student Branches. This recommendation likewise was approved by the committee on planning and co-ordination and by the executive committee. The President requested the committee on Student Branches to work with representatives of other societies in developing a specific plan of co-operation. A subcommittee is actively at work on this project. (Editor's Note: Approved by the board of directors at its winter convention meeting January 24, 1946, on the basis of the recommendation made by the committee on planning and co-ordination, which included the clarifying statement that "it should be emphasized that the intention of this suggested change in policy is to make joint Student Branches permissive wherever such an organization would be beneficial, and not to make the joint branch mandatory.")

Establish a New Institute Office to Relieve the Burden of the Presidency. From a number of proposals, the subcommittee recommended to the committee on planning and co-ordination the establishment of an elective office of senior vice-president. Although there is general agreement that something should be done to assist the president, and to secure the guidance of a wider acquaintance with the membership and workings of the Sections in the appointment of committees, the committee on planning and co-ordination sent the recommendation back to the subcommittee for further study. After reconsideration the subcommittee decided to continue its efforts to establish an elective office of the executive vice-president type.

Organization of the Engineering Profession. The subcommittee drew up four possible plans of organization and, after experience gained at the winter convention conference on January 23, 1946, has revised its plans for publication in the April issue of *Electrical Engineering*. In addition to publication these plans are to be discussed at three District meetings in April and May and at several Section meetings also. These discussions will cover the work of both subcommittees, and questionnaires have been developed for use in obtaining views of those who attend discussion meetings and of other active members. The results of these questionnaires will be brought to the attention of the committee on planning and co-ordination after enough returns have been received to be significant. (Editor's Note: Representatives of the committee on planning and co-ordination have been invited to attend various District and Section meetings to discuss the work of the committee and to gain direct membership reactions for the guidance of the committee in its further work. W. S. Hill (M '30) of Buffalo, represented the professional activities subcommittee at a meeting of the Boston Section February 15, and at a conference held during the North Eastern District meeting at Buffalo, April 24–26. J. F. Fairman of New York (F '35) chairman of the committee on planning and co-ordination, attended a meeting of the Pittsfield Section, February 19, the annual meeting of the New York Section, April 25, the annual meeting of the Lynn Section, April 30, and is scheduled to attend the Southern District meeting at Asheville, N. C., May 14–16. T. G. LeClair of Chicago, chairman of the professional activities subcommittee, led the conference discussion at the South West District meeting in San Antonio, April 16–18.)

Activities of Special Interest to Young Employed Engineers. The subcommittee is endeavoring to find out what the problems and needs of the younger engineer–employees are, and what can be done by the Institute to get and keep their interest.

Other Recommendations. The subcommittee has on its agenda other items for which definite recommendations will be prepared and submitted to the committee on planning and co-ordination at a later date.

SUBCOMMITTEE ON TECHNICAL ACTIVITIES

The following report was prepared by M. D. Hooven (F '44) chairman of the technical activities subcommittee, and also chairman of the AIEE technical program committee.

Review of Functioning of Technical Organization of Other Societies. The method of operation of some 30 national engineering societies was reviewed in detail by the various technical committee chairmen. Their comments and reports were analyzed and presented at the March 15 meeting of the technical program committee, this material being considered as background for further discussion of the organization of the technical activities of AIEE. Having served their purpose the reviews will be turned over informally to the Engineers' Joint Council.

Additional Convention to Be Held in Chicago. The subcommittee, acting at the behest of the technical program committee, has reported to the planning and co-ordination committee that for the purpose of providing an outlet for more technical papers and for initiating the technical activities of the Institute earlier in the administrative year, Section 27 of the bylaws be changed to add an October convention, to be known as the Midwest convention, to the three national conventions now held. (Editor's Note: Approved by executive committee of the board of directors at meeting April 10, 1946; proposed amendment to bylaws to be referred to committee on constitution and bylaws.)

Winter (New York) Convention to Be Held in Hotel. The subcommittee, with the support of the technical program committee, has recommended to the expiring winter convention committee that it transmit to its successors an instruction that effort should be made to hold the next winter's convention in a hotel rather than in the Engineering Societies Building. The winter convention committee is making this recommendation to the board of directors. (Editor's Note: Approved in principle by the executive committee of the board of directors at meeting April 10, 1946, subject to final action by the board.)

Exhibits in Conjunction With Convention or District Meetings. The subcommittee, pursuant to a motion of the technical program committee that the Institute actively take under advisement the matter of sponsoring exhibits in conjunction with conventions, has recommended to the winter convention committee that Section 29 of the bylaws be revised to include rather than exclude the possibility of exhibits of commercial products. The winter convention committee is recommending this change to the board of directors. (Editor's Note: Approved in principle by the executive committee of the board of directors at meeting April 10, 1946, subject to final action by the board.)

District Meetings on Specific Subjects. At the 1946 winter convention conference, Professor Turner spoke on the advisability of holding technical conferences on specific subjects at specific locations, an idea that has received support from many sources. The subcommittee has recommended to the technical program committee that beginning immediately effort should be made to present national programs on specific subjects at District meetings located at points where some particular theme might be of importance. The technical program committee in endorsing the idea has recommended to the technical committees that such sessions be planned as soon as possible. The secretary of the technical program committee has been instructed to co-ordinate this activity with each District planning to sponsor a meeting during the next administrative year.

Closer Co-operation With Committees of Other Organizations. In discussion of Plan A (The Coover proposal for a combined electrical engineering society) at the technical program committee meeting of March 15, it was agreed generally that open overtures for union should not as yet be made to other national electrical engineering bodies, but that closer co-operation with them on technical work should be immediately entered into. Accordingly, a motion was passed that the secretary write to the chairmen of all technical committees calling attention to Section 86 of the bylaws which encourages such co-operation, urging each chairman to review all contacts and explore the possibility of establishing others. Since that meeting, several possibilities of joint meetings with outside technical committees have come up for consideration.

Problems of Papers Arising in Joint Meetings With Other Societies. In the discussion of greater co-operative technical effort with other societies as outlined in the foregoing item, the traditional prohibition of joint publication of papers with other societies was discussed with the result that the technical program committee voted to urge that consideration be given to joint publication of papers of mutual interests with other engineering bodies. Since the ban seems

to be in the sentence, "No manuscript, any appreciable portion of which has been published elsewhere, is acceptable," which is contained in the publication committee portion of the pamphlet, "Information for Authors," the subcommittee has entered into discussion with the publication committee concerning the lifting of this limitation.

General Publication Policy. It developed in the discussion of the previous item that there were many views as to how the general publication policy of the Institute could be bettered. In its past work of accumulating suggestions on the technical organization of the Institute, the subcommittee has received scores of such suggestions. It is at present compiling and correlating these suggestions into compact form for discussion with the publication committee and for further discussion at the next meeting of the technical program committee.

Organization of Institute Technical Activities. Subsequent to the 1946 winter convention conference discussion on the Alger proposal, the receipt of similar proposals, and technical program committee discussion of possible variations in the original one, the technical program committee voted that at its May meeting the chairmen of the technical committees present should be prepared to form councils where there are mutual interests. These councils will meet in the afternoon and discuss further methods of co-ordinating the activities of technical committees which lie in the same field.

Standard on Automatic Stations Revised to Include New Material

Standard definitions, standard tests, and a standard language of numbers for identifying on drawings and on the devices themselves the many complicated devices making up a complete equipment are given in the revised "American Standard for Automatic Station Control, Supervisory, and Telemetering Equipment," C37.2-1945. The new standard also includes a table indicating the minimum protection that should be given to power apparatus and feeders.

With this new national Standard, which provides dielectric tests for supervisory control and telemetering equipment, it is expected that the use of such remote-control equipment will be increased and that easier operation of all centralized systems of electric power control will result.

Originally prepared as AIEE Standard 26, by the Institute's committee on automatic stations, the Standard was referred to committee C37 in 1936, and reissued as an approved American Standard in October of 1937. Early in 1945 the 1937 edition was revised and enlarged by the AIEE committee on automatic stations, later reviewed by the ASA Sectional Committee on Power Switchgear C37, and approved as an American Standard December 11, 1945. More accurately to fit the enlarged scope, the title was changed in the revision to the "American Standard for Automatic Station Control, Supervisory, and Telemetering Equipment." Minor changes also were made in the definition, to correspond to the definitions for these same terms in related American Standards, such as those for a-c power circuit breakers.

The following digest of the revised standard is based upon material prepared by George Sutherland (F '27) of the Consolidated Edison Company of New York, Inc., and G. S. Lunge (A '23) of the General Electric Company, Schenectady, N. Y. Mr. Sutherland is chairman of the ASA Sectional Committee on Power Switchgear C37, and represents the Electric Light and Power Group. Mr. Lunge is secretary of the same committee and represents the AIEE.

NEW MATERIAL NOW INCLUDED

Because the close similarity of many names of feeder types (stub feeder; multiple feeder; stub–multiple feeder; and so forth) may lead to confusion, simple one-line diagrams now are used to illustrate the definitions for these terms.

Another important addition in the new Standard is the specification of dielectric test voltages for supervisory control and telemetering equipments. Such equipment is not covered by any other existing American Standard, whereas practically all other individual devices used in automatic stations already are governed by existing national standards.

PRINCIPAL CHANGES SINCE 1937

One of the principal changes in the Standard since the 1937 edition concerns the use of numbers for device functions. Each device in an automatic switching equipment has a device function number which is placed adjacent to the device symbol on all wiring diagrams and arrangement drawings. In addition it is attached to or located adjacent to each device, so that it may be readily identified.

When device function numbers were first introduced for use in automatic stations, each manufacturer established his own standard series of numbers from 1 to 99. Later, to the temporary discomfiture but ultimate satisfaction of those having to use elementary or other diagrams for automatic station equipment, a single series of device function numbers from 1 to 99 for use by all manufacturers was adopted.

It was this common language of automatic switchgear practice that appeared in the "AIEE Standard 26 for Automatic Stations" published in April 1928 and revised in 1930. A few changes in the meanings of these standard numbers were made in the 1937 edition of the "American Standard for Automatic Stations," chiefly in the direction of generalizing or broadening the significance of some of these numbers. This tendency is again evident in the 1945 edition of the Standard.

NEW FUNCTIONS DEVELOPED RECENTLY

During the last eight years, the need for certain device functions has largely disappeared, at least in new equipments, and the standard device numbers thus freed have been eagerly seized upon to cover new functions that were not contemplated a quarter of a century ago when use of these standard device numbers first became general. Increasing use of mercury-arc rectifiers, distance relays, and pilot protection schemes, for example, has occasioned the use of some new device function numbers. More recently it has become common practice to use these convenient numbers for *all* types of switchgear equipments and not in automatic stations only.

This also has made it desirable to include 29 standard letter suffixes for the device numbers (instead of the 17 suffixes in the 1937 Standard), and further expansion of these undoubtedly will occur in the future. The letter *A*, for example, is used to indicate air, automatic, or accelerating auxiliary devices; *B* for blower; and *BB* for bucking bar for high speed circuit breaker.

Only 99 different standard device numbers are conveniently possible. When, for instance, the meaning of automatic device 4 in a machine equipment is established, this also fixes the meaning of devices 104, 204, and 304 in a reclosing (or automatic transfer) feeder, supervisory controlled machine, and supervisory controlled feeder equipment, respectively. Of these 99 in the 1937 Standard, 13 were unassigned and could be used at will. In the 1945 edition of the Standard only 8 are still available for such miscellaneous functions in individual installations.

Gone from the list are:

57. Current regulating relay (now 90C)
58. Voltage regulating relay (now 90V)
84. Generator relay (now combined with exciter relay 53)
85. Commutation control relay
95. Closing relay

Newly assigned device function numbers include:

7. Anode circuit breaker
21. Impedance relay
69. Permissive control device
74. Alarm relay
75. Position changing mechanism (for a removable circuit breaker unit)
77. Impulse transmitter
81. Frequency device
85. Carrier (or pilot wire) receiver relay

These 99 standard device numbers constitute the switchgear equipment engineer's shorthand, which already has saved an incalculable amount of time in making and using electrical diagrams and instruction books. By using numbers rather than letters for the basic functional designations,

this system transcends language barriers and may in time become international. It is also conveniently usable with appropriate letter suffixes to designate auxiliary devices or important electrical components of a complicated device.

A few changes also will be noticed in the table showing the minimum protection to be provided for automatically controlled power apparatus and feeders. In addition to naming the types of protection required, this table now lists the function numbers of the devices, one or more of which would be used to provide each type of protection.

An automatic station, if unattended, ordinarily will contain, besides the main power apparatus (machines, transformers, rectifiers, and so forth):

(*a*). Automatic switching equipment, *to control the individual steps* involved in putting each machine or feeder in or out of service. This uses devices in the series 1 to 99 and 101 to 199.

(*b*). Telemetering equipment, to give the dispatcher or supervisor, located elsewhere, *quantitative information* on the performance of the machines or circuits in the automatic station.

(*c*). Supervisory control and indication equipment, *to show the dispatcher, by means of lamps* and audible signals, the operating position of all circuit breakers and power-operated switches and *permit him to control* the station remotely. This uses devices in the series 201 to 299 and 301 to 399.

The 1937 edition of the Standard covered only the first of these three classes of equipment. Although some small automatic stations have no provision for remote (supervisory) control of machine output or voltage level, and the machines start and stop automatically in response to water-level, voltage, or current conditions, or to a time switch, in the majority of recent installations supervisory control of these functions is considered an indispensable adjunct to the automatic switching equipment at the unattended station. The fact that an American Standard is available governing at least the dielectric test requirements for supervisory control and telemetering equipment should increase confidence in such equipment and foster its wider application, with resulting increased ease of centralized system operation.

Standards Proposed for Pool-Cathode Mercury-Arc Power Converters

Representing the first such venture into the field of mercury-arc rectifiers, a "Proposed Standards for Pool-Cathode Mercury-Arc Power Converters" has been prepared under the auspices of the subcommittee on electronic power converters of the AIEE committee on electronics. This new draft is an up-to-date revision of the original AIEE "Report (number 6) on Standards for Acceptance Tests for Metal Tank Mercury-Arc Rectifiers" issued in June 1934. Currently, this material is being processed at AIEE headquarters in New York, and is expected very soon to be available in the form of a "Report on Proposed Standards" which will be available from the secretary of the AIEE Standards committee at Institute headquarters, 33 West 39th Street, New York 18, N. Y.

These proposed standards have not been approved by the AIEE Standards committee, nor have they been considered by the American Standards Association's C34 Sectional Committee. Publication previous to approval by these groups is made to present the proposed Standards to a wider engineering public and to facilitate suggestions and criticism.

The need for adequate standards has been recognized for some time. The only material of standards form previously available has been the AIEE "Report on Standards for Acceptance Tests for Metal Tank Mercury-Arc Rectifiers" number 6 issued in June 1934. This report is only tentative in nature and does not cover many recent developments such as the ignitron, excitron, sealed tubes, and the use of phase control. The large number, size, and variety of applications made since the issuance of Report 6 has provided an excellent background for the development of the new Standards.

The new terms and definitions proposed in the Standards are a feature of particular interest. They represent an endeavor to provide a systematic nomenclature and an exact terminology embodying the basic concepts of rectifiers. The development of an exact terminology has required the selection and definition of new terms and the redefinition of old terms. These terms have been defined to conform primarily with practice in the power rectifier field, although cognizance has been taken of established practice in other fields employing rectifiers. It is proposed that the terminology developed in these Standards be adopted for all rectifiers where applicable. This would eliminate some of the present confusion caused by the lack of an exact terminology.

As a preview, some of the salient features of the proposed Standards are presented in the following paragraphs, as prepared by Professor C. H. Willis (F '42) of Princeton University, who is chairman of the subcommittee on electronic power converters of the AIEE committee on electronics, and also chairman of the ASA Sectional Committee C-34 on Mercury-Arc Rectifiers. Many of the factors entering into the development of the terms and the definitions of the new terminology also are discussed.

SCOPE

These standards apply to all types of mercury-arc power converters, employing rectifying devices with mercury pool cathodes and used for power conversion purposes, including mercury-arc power rectifiers, mercury-arc power inverters, electronic frequency changers, and converters used with electronic motors when these equipments employ mercury-arc rectifying devices with pool cathodes. These standards do not apply to welding rectifiers nor electronic power converters employing rectifying devices with thermionic cathodes.

DEFINITIONS

The development of the new Standards has necessitated the definition of a large number of terms, some of which have become established by usage, and others are new terms which have been devised to meet growing needs. There also has been need for the development of a consistent and systematic nomenclature, adequate for immediate needs yet flexible enough to provide for future development.

In the preparation of definitions the "American Standard Definitions of Electrical Terms," ASA C42, 1941, has been used as a guide. Wherever possible the terms and definitions set forth in this Standard have been adopted. However, new terms or new definitions have been proposed wherever the existing definitions were inadequate or inconsistent.

The terminology of the new Standards provides a systematic nomenclature for device names, circuit names, and the classification of circuits. The essential features of this nomenclature are as follows.

Device Names. The system of device names starts with the elemental device, builds up the various apparatus assemblies, and concludes with the complete equipment. The first of the device names are structurally descriptive. They start with the general term "electron tube" and proceed with the more restrictive terms, "gas tube" and "pool tube."

1.001 Electron Tube. An electron tube is a device consisting of an evacuated enclosure containing a number of electrodes between two or more of which conduction of electricity through the vacuum or contained gas may take place. (70.10.010 Mod)*

1.002 Gas Tube. A gas tube is an electron tube in which the pressure of the contained gas or vapor is such as to affect substantially the electrical characteristics of the tube. (70.10.020 Mod)

1.008 Pool Tube. A pool tube is a gas tube with a pool cathode.

The second group of device names are functionally descriptive. These are the "rectifying device" and various components.

1.009 Rectifying Device. A rectifying device is an elementary device, consisting of one anode and its cathode which has the characteristic of conducting current effectively in only one direction.

1.003 Anode (of an electron tube). An anode of an electron tube is an electrode to which a principal electron stream flows. (70.15.005 Mod)

1.004 Cathode (of an electron tube). A cathode of an electron tube is an electrode which is the primary source of electron emission. (70.15.015 Mod)

The term "rectifier" has a wide usage as a general name. It was felt that this usage had become so well established that it would be undesirable and impractical to change it, and therefore it has been retained and defined in accordance with present practice.

1.010 Rectifier. A rectifier is an integral assembly of one or more rectifying devices.

1.011 Mercury-Arc Rectifier. A mercury-arc rectifier is a rectifier consisting of one or more mercury-vapor gas tubes.

Various types of rectifiers are defined as follows: Single-anode tube (tank), multi-anode tube (tank), ignitron, excitron, pumped rectifier, and sealed tube.

Complete equipments employing rectifying devices may function in several ways, namely as rectifiers, inverters, frequency changers, and so forth, and a need was felt for a general term covering all such equipments. It is proposed to cover such equipments under the general term "electronic power converter."

1.018 Electronic Power Converter. An electronic power converter is an equipment which employs electronic devices for transforming electric power.

The term "rectifier unit" is used to describe a complete operative assembly as follows:

1.019 Rectifier Unit. A rectifier unit is an operative assembly consisting of the rectifier(s), the rectifier auxiliaries, the rectifier transformer equipment, and the essential switchgear. (15.50.040 Mod)

Various types of operation are defined by the terms "power rectifier," "power inverter," "electronic frequency changer," and so forth.

Classification of Circuits. A confusing and unsatisfactory circuit nomenclature has grown up as a result of the application of the terms "half wave" and "full wave" to polyphase power rectifier circuits. In order to avoid these difficulties, the terms "single way" and "double way" have been proposed.

1.202 Single-Way Rectifier. A single-way rectifier is a rectifier in which the current between each terminal of the alternating voltage circuit and the rectifying element (or elements) conductively connected to it flows only in one direction.

1.203 Double-Way Rectifier. A double-way rectifier is a rectifier in which the current between each terminal of the alternating voltage circuit and the rectifying elements conductively connected to it flows in both directions.

The terms single-way and double-way provide a means for describing the effect of the rectifier circuit on current flow in transformer windings connected to rectifiers. Most rectifier circuits may be classified in these two general types. In practice a circuit is assumed to be single-way unless it is specifically stated as double-way.

It is recognized that the terms "half wave" and "full wave" have a wide usage and are entrenched so firmly in practice that it would be impractical to supplant them. Definitions of these terms are not included in the proposed standards but in order to prevent the erroneous use of these terms and yet retain them, it is suggested that they be redefined as follows:

Half-Wave Rectifier Circuit. A half-wave rectifier circuit is a circuit which has a single rectifying element and changes alternating current into unidirectional current, utilizing only one half-cycle of the a-c wave. (Refer to ASA 60.41.010 and 65.20.030.)

Full-Wave Rectifier Circuit. A full-wave rectifier circuit is a circuit which has two rectifying elements and changes alternating current into unidirectional current, utilizing both half-cycles of the a-c wave. (Refer to ASA 60.41.015 and 65.20.025.)

To facilitate classification of the different circuits on the basis of circuit action, the "commutating group" is defined.

1.205 Commutating Group. A commutating group of a rectifier is a group of rectifying elements and the alternating voltage supply elements conductively connected to them in which the direct current of the group is commutated between individual elements which conduct in succession.

Simple, multiple, parallel, cascade, and series rectifiers are defined in terms of the arrangement and number of the commutating groups.

In the analysis of rectifier circuits, one or more rectifying devices may be treated as a single circuit element. Such a circuit element is defined as a "rectifying element."

1.201 Rectifying Element (circuit element). A rectifying element is a circuit element which has the property of conducting current effectively in only one direction.

When a group of rectifying devices is connected, in either parallel or series arrangement, to operate as one circuit element, the group of rectifying devices should be considered as a rectifying element.

The windings of rectifier transformers are identified by the terms "d-c winding" and "a-c winding." These terms avoid the difficulties encountered in the use of the terms primary, secondary, high voltage, and low voltage when applied to transformers for electronic power converters.

5.102 D-C Winding of Rectifier Transformer. The d-c winding of a rectifier transformer is the winding which is connected conductively to the main electrodes of the rectifier, or which conducts the direct current of the rectifier.

5.103 A-C Winding of Rectifier Transformer. The a-c winding of a rectifier transformer is the winding which is connected to the a-c circuit and usually has no conductive connection with the main electrodes of the rectifier.

Circuit Names. A comprehensive table of rectifier circuits giving circuit diagrams and names is included in the Standards. This rectifier circuit nomenclature is based on a descriptive name given in the following order:

1. The connection of the transformer a-c windings.
2. The number of phases of the rectifier unit.
3. The connection of the transformer d-c windings and rectifying elements.
4. Type of circuit (that is, single-way or double-way, single-way assumed unless otherwise stated).

In describing multiple rectifiers the prefixes double, triple and quadruple are used to indicate the number of component simple rectifiers and the names diametric, wye, cross, star, zig-zag, fork, aster, and so forth, are used to denote the connection of each component simple rectifier. The circuits are shown in Table II of the Standard.

STANDARDS

Standards establish usual and unusual service conditions, designate classifications for ratings, prescribe the basis on which performance characteristics shall be specified, and specify certain minimum requirements for acceptance tests.

The standards include a treatment of rectifier performance characteristics with phase control.

TEST CODE

The test code sets forth accepted test practices as a guide in making acceptance tests to demonstrate the performance of rectifier units. It applies to both the rectifier units and their component parts.

Features of this test code are a new method for measuring arc drop with the rectifier operating under load and procedure for determining power factor and regulation.

RECOMMENDED PRACTICE AND OPERATING GUIDE

This guide covers general recommendations for loading and operating rectifier units of the type covered by the standards.

In connection with this part of the proposed standards, a report titled "Inductive Co-ordination Aspects of Rectifier Installations" has been prepared covering the procedure for predicting the effect of rectifier wave shape upon adjoining communication systems.

RECTIFIER TRANSFORMERS

Inasmuch as the action of the rectifier imposes definite and special requirements on the associated transformer equipment, a supplementary section on transformers is included in the standards. It is expected that this eventually will be incorporated in the appropriate transformer standards.

It is proposed that standard name-plate markings for rectifier transformers shall include the commutating reactance of a single commutating group expressed in line-to-neutral ohms referred to the d-c winding, in addition to the usual percentage impedance which usually is given on power transformers. The proposed transformer standards also include two methods for determining rectifier transformer load losses for the various circuits given in the table of circuits.

Copies of the proposed standards may be obtained upon request from: the Secretary, AIEE Standards Committee, 33 W. 39th Street, New York 18, N. Y., and comments pertaining to them should be sent to the same address.

Members Urged to Place "Supplement" Orders Early

Members desiring the June 1946 *Supplement to Electrical Engineering—Transactions Section* are urged to place their orders before June 15, 1946, to insure obtaining their copies upon publication. Members with standing orders, however, need make no further reservation; upon notification to Institute headquarters, a standing order may be arranged at any time.

This supplement to *Electrical Engineering* will contain technical paper discussions which are not published in the monthly issues. Its price is 50 cents to members and it may be ordered from the AIEE Order Department, 33 West 39th Street, New York 18, N. Y. Further details of the supplement's contents and availability will be announced in this section in a subsequent issue.

* Paragraph numbers of terms defined in ASA C42-1941 are given in parentheses, and, if a change in the C42 definition is proposed, the notation "Mod" is added. Unmarked definitions are new.

San Francisco Section Fetes Past Officers

The AIEE San Francisco Section feted past officers of the Section at a gala dinner meeting on April 1, 1946, "Institute Officers' Night." The past officers were honored during the first portion of a twin program. Of 30 living past chairmen and officers, two, AIEE secretary H. H. Henline (F '43) New York, N. Y., and P. B. Garrett (M '30) editor, *Electric Light and Power*, Chicago, Ill., responded by mail and 24 were present in person for the occasion. Section Chairman D. I. Anzini (M '38) turned over the introduction of the past chairmen to S. J. Lisberger (F '39) chairman of the San Francisco Section during 1910–11, the oldest chairman present in point of time of chairmanship.

The second portion of the program was devoted to an address by AIEE President William E. Wickenden (F '39) on "Engineers and Public Policy." Doctor Wickenden's address before the San Francisco Section was one of three Institute appearances in the San Francisco Bay region during his recent tour of Districts 8 and 9 (Pacific and North West Districts). He also had spoken to the University of California Branch on "Science and Security" as well as visiting at the Stanford University Branch. Mrs. Wickenden was among the women present.

The following past officers attended the meeting:

Past Chairmen S. J. Lisberger, 1910–11; J. P. Jollyman, 1920–21; W. P. L'Hommedieu, 1921–22; J. A. Koontz, 1923–24; F. R. George, 1924–25; D. I. Cone, 1926–27; W. L. Winter, 1927–28; B. D. Dexter, 1928–29; L. F. Fuller, 1929–30; E. A. Crellin, 1931–32; E. F. Maryatt, 1932–33; W. C. Smith, 1933–34; A. M. Bohnert, 1934–35; E. M. Wright, 1935–36; H. S. Lane, 1936–37; R. O. Brosemer, 1937–38; F. S. Benson, 1938–39; C. A. Andrews, 1939–40; M. S. Barnes, 1941–42; B. L. Robertson, 1942–43; C. E. Baugh, 1943–44; and G. C. Tenney, 1944–45. Also *Past Secretary* A. G. Jones, 1910–29; and A. W. Copley, former *vice-president* of District 8, 1931–33.

Regrets were received from the following:

Past Chairmen C. W. Burkett, 1908–09; H. H. Henline, 1922–23; R. C. Powell, 1925–26; P. B. Garrett, 1930–31; and C. V. Fowler, 1940–42.

Seated left to right at the San Francisco Section dinner are: W. C. Smith (F'40), President Wickenden, Section Chairman Anzini, and Past Chairmen Lisberger and Jones

Washington Section Concludes Year With Technical Groups

April 1946 marked the conclusion of the AIEE Washington Section's first year of experience with technical discussion groups. The program for the year provided for eight scheduled meetings under the auspices of five groups which were organized under the direction of W. J. Lynott, Jr., (M '42). Under this system the following groups were formed and a chairman appointed for each to obtain speakers and to preside over the meetings: electronics, Albert Preisman (M '41), chairman; communications, Davis S. Bender (M '42), chairman; research, Almon W. Spinks (M '45), chairman; power, William J. Lank (M '42), chairman; and electrical engineering mathematics, H. L. Sangster (A '41), chairman.

The selection and number of subjects for discussion during the sessions of the technical groups was influenced by the replies to a questionnaire sent to the membership. This questionnaire indicated that 125 members preferred electronics, 83 preferred communications, 61 preferred electrical research, 60 preferred power systems, and 48 preferred electrical engineering mathematics. On the basis of this information the following subjects were presented: "The Cyclotron, Its Theory and Application," by Dean B. Cowie, Carnegie Institute of Washington; "Frequency Modulated Broadcasting," Everett L. Dillard, owner of radio station WBXL; "Power System Planning," W. F. Lank and F. S. Black (M '44), Potomac Electric Power Company; "Self-Synchronous Transmission Units," M. R. Walters, Bureau of Ordnance, Navy Department; "Important Concepts of Electrical Engineering Mathematics," E. L. Harder (M '41), Westinghouse Electric Corporation; "The Electron Microscope," James Hillier, RCA Laboratories; "Multistation Microwave Chain Radio Transmission," H. S. Black (F '41), Bell Laboratories; and "A Survey of Microwave Radio Measurements," Harold Lyons, Radio Section, National Bureau of Standards.

Niagara Subsection Holds Inaugural Meeting

The newly formed AIEE Niagara District Subsection held an inaugural meeting and dinner at the Foxhead Inn, Niagara Falls, Ontario, Canada, on March 21, 1946, with 50 members and guests in attendance. This Subsection developed out of the AIEE Niagara District discussion group and will continue to co-operate with the Niagara Falls (N. Y.) Subsection in all activities.

A. H. Frampton (F '45) chairman of the Toronto (Ontario) Section was in charge of the preliminary proceedings and conducted the election of the executive officers of the Subsection. The following officers were elected: *chairman*, J. I. Gram (M '28); *secretary–treasurer*, W. G. A. Barr (A '44); *chairman of program committee*, C. W. Baker (M '34); and *chairman of membership committee*, E. O. Scott (A '36). Congratulations were tendered the Niagara District members on the formation of the Subsection by J. T. Thwaites (M '44) representing the Hamilton (Ontario) Subsection and E. Bond (M '43) representing the Niagara Falls Subsection.

The second portion of the program, under the chairmanship of Mr. Gram, was devoted to an address by G. D. Floyd (M' 28) Hydro-Electric Power Commission of Ontario, on "Field Tests of the Interrupting Capacities of 138-Kv Oil Circuit Breakers." The address was followed by a discussion period. K. V. Farmer (M '21) proposed a vote of thanks to the speaker.

Pittsfield Section Studies Organization of Profession

To give fullest consideration to proposals to reorganize the engineering professional societies, the AIEE Pittsfield Section recently devoted two meetings with featured addresses and informal discussion to that subject. The meetings will be supplemented by news letters, and distribution of a questionnaire is comtemplated to bring as much information as possible before the Section membership.

At the first meeting held February 19, James F. Fairman (F '35) AIEE vice-president and chairman of the committee on planning and co-ordination, spoke on "Organization of the Engineering Profession." For several weeks before the meet-

ing, interested individuals and committee members had participated in numerous discussions concerning the subject, and a round table conference with Mr. Fairman was held during the afternoon preceding the meeting.

In his address Mr. Fairman reviewed the work of his two special committees on technical and professional activities and the four tentative plans of reorganization of the engineering profession.

AIEE President W. E. Wickenden addressed the section on the same topic on March 15.

New Discussion Group Meets. The first meeting of the newly formed basic science discussion group of the Philadelphia Section was held jointly with the Franklin Institute on March 27, 1946, with approximately 218 members and guests in attendance. C. N. Weygandt (A '37) of the University of Pennsylvania addressed the group on the theory of servomechanisms. The talk, which was illustrated by slides and demonstrations of models of servomechanisms, was followed by a lengthy discussion period.

Delaware Student Branch. Resumption of activities by the University of Delaware Student Branch on March 26, 1946, was announced by Miss Frances B. Cummins, Student Member, at a recent meeting of the Wilmington Subsection. During the past two years the Wilmington Subsection has been filling the gap in activities of the Student Branch by inviting the Student Members and members of the faculty to attend the Subsection's meetings. The University of Delaware Student Branch's first meeting was based on electrical heating with a talk by Miss Cummins on "Dielectric Heating" and a motion picture on induction heating as features.

ABSTRACTS • • •

TECHNICAL PAPERS previewed in this section will be presented at the AIEE Southern District meeting, Asheville, N. C., May 14–16, 1946, and will be distributed in advance pamphlet form as soon as they become available. Copies may be obtained by mail from the AIEE order department, 33 West 39th Street, New York 18, N. Y., at prices indicated with the abstract; or at five cents less per copy if purchased at the meeting registration desk.

Mail orders will be filled AS PAMPHLETS BECOME AVAILABLE

46-101-ACO—Co-ordinated Communication System Speeds TVA Operations; *T. D. Talmage* (*M '40*). *30 cents.* This paper outlines the development and present extent of communication and control systems used by the Tennessee Valley Authority. Intrasite manual and automatic telephone installations have been co-ordinated with various types of intersite circuits for integrated operation. Most of the intersite circuits are secured by superimposing carrier upon power lines. The carrier equipment is of three types:

1. Amplitude modulated.
2. Frequency modulated.
3. Frequency shift.

These channels furnish vital services, such as telemetering, pilot relaying, remote tripping and closing of oil circuit breakers, load-frequency control, high-speed printer telegraph, and telephony. Radio is used for rain and stream-flow gauging purposes, bridging defective sections of telephone lines, as well as two-way communication with mobile units. This paper describes the principal features of a balanced combination of modern communication facilities and services which handle 2,500,000 telephone calls a year.

Communication

46-102—Factors Affecting Range of Radar Sets; *L. R. Quarles* (*M '45*), *W. M. Breazeale*. *15 cents.* The type of antenna and reflector determine the energy in the projected beam and the beam width. Of the portion of this energy intercepted by an airplane, a fraction is returned to the station. The combination of the antenna and airplane factors then gives the power returned in terms of transmitted power. This received power must give enough signal-to-noise for satisfactory operation of the receiving equipment. An equation for the range of a radar set is developed by considering these various factors. This indicates that the range is proportional to the fourth root of the peak transmitted power and the fourth root of the effective reflector cross section.

Electronics

46-96—Maintenance of Rectifiers on Electrochemical Installations; *J. E. Housley* (*F '43*), *G. N. Hughes* (*M '43*). *15 cents.* Operating experiences and information gained over a period of years from the operation of a large group of mercury-arc rectifiers have shown that, though the rectifier is a very economical means of converting from a-c to d-c power it is not entirely trouble free. The principal operating difficulty has been the seemingly inherent tendency for a rectifier to arc-back. This peculiarity has challenged both the designer and operator since it has been found that both contribute toward the solution. The present paper presents the features which have been found advisable for the operator to observe and control in order to keep the arc-back rate at a minimum.

Industrial Power Applications

46-97—Lightning Protection for Industrial Plants; *Edward Beck* (*M '35*), *J. Z. Linsenmeyer* (*M '43*). *15 cents.* Under this subject is considered lightning protection for the buildings and for the electric circuits and equipment in the buildings. For the type of plant being considered, principally textile mills, the circuit voltage is assumed to be generally of the order of 550 volts alternating current. Power usually is supplied from a transmission or distribution system through a step-down transformer. It is assumed that the high voltage side of the transformer is protected sufficiently to assure continuity of power supply to the plant. The plant circuits themselves may be subject to lightning disturbances, depending on the degree of exposure and the degree of lightning frequency and intensity. The most vulnerable piece of equipment on the circuits is the motors. Such exposed circuits should be equipped with capacitors and arresters to safeguard the motors and other apparatus. In some cases overhead ground wires or lightning rods may be advisable also.

Protective Devices

46-98-ACO—Selective Ground Relaying of an Ungrounded System; *E. P. Miller* (*M '45*). *15 cents.* This paper describes a method of providing selective ground relaying of an ungrounded delta-connected system. Essentially the scheme consists in using the system capacitance to ground in lieu of a grounding bank to supply the currents needed for the selective relays, and a set of Y-open delta potential transformers to supply a voltage with which to compare these currents. Basic formulas, applicable to any ungrounded system, are derived, and figures are substituted in the formulas showing how the method was applied to one particular problem. Brief descriptions of the relays used and of the tests made are included. It is noted that this method of protection compares very favorably both in cost and in operating characteristics with the protection afforded by a grounding bank and conventional ground relays.

PERSONAL • • • •

C. T. Evans (A '11, M '20) formerly development engineer, Cutler-Hammer, Inc., Milwaukee, Wis., has been named consulting engineer. Mr. Evans was graduated from Ohio State University in 1908 and that year joined the Cutler-Hammer company as a student engineer. He then became a member of the engineering department and was one of the original members of the company's development department in 1924. In 1935 he was made supervising development engineer. During World War II he served as a member of the controller development committee of the Navy Department's Bureau of Ships. Mr. Evans is a member of the Engineers' Society of Milwaukee, the American Association for the Advancement of Science, and the International Association of Electrical Inspectors. **C. W. Kuhn** (A '23, F '39) formerly supervising engineer, development department, Cutler-Hammer, Inc., has been made

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J. W. Barker

assistant manager of development. Mr. Kuhn joined the Cutler-Hammer company in 1923 after his graduation from the University of Cincinnati as a student engineer. After two years in the experimental department he was transferred to the development department and in 1938 was made a supervising development engineer. He is a member of the American Society of Refrigeration Engineers, the American Interprofessional Institute, and the Engineers' Society of Milwaukee. **R. A. Millermaster** (M '34) formerly supervising development engineer, Cutler-Hammer company, also has been made assistant manager of development. A 1927 graduate of the University of Wisconsin, Mr. Millermaster entered the employ of the company as a student engineer. He has since been a member of the drafting, experimental, and developments departments of the company. He is chairman of the AIEE committee on aircraft electrical control and protective devices and of several committees of the National Electrical Manufacturers Association. He also is a member of the Engineers' Society of Milwaukee.

J. W. Barker (M '26, F '30) dean of the school of engineering, Columbia University, New York, N. Y., has resigned to become president of the Research Corporation, New York, N. Y., a foundation for the support of investigations in educational and scientific laboratories throughout the United States. Doctor Barker has been a member of the board of directors of the corporation for some time and had served on a part-time basis as acting director since January 1945. Doctor Barker, who holds the degrees of bachelor (1916) and master (1925) of science from Massachusetts Institute of Technology, entered the teaching profession there in 1925 as professor of electrical engineering. In 1929 he became professor and head of the department of electrical engineering at Lehigh University and in 1930 was appointed dean at Columbia University. From 1941 to July 1945 Doctor Barker served as special assistant to the Secretary of the Navy in charge of the Navy's educational and training programs and for this service received the Distinguished Civilian Service Award. He is a member of the advisory committee of the United States Coast Guard Academy, New London, Conn., and of the United States National Committee of the International Commission on Illumination. He also is a member of the American Association for the Advancement of Science, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the New York Electrical Society, the Newcomen Society, Sigma Xi, and Tau Beta Pi.

Robert Paxton (A '26, M '40) formerly manager, Philadelphia (Pa.) works of the General Electric Company, recently was appointed manager of the General Electric Pittsfield (Mass.) apparatus works. Mr. Paxton became associated with the General Electric Company after being graduated from Rensselaer Polytechnic Institute in 1923. He began in the switchboard department in Schenectady, N. Y., and later was transferred to the oil circuit breaker engineering division in Philadelphia. In 1929 he was made managing engineer of the metal enclosed division and in 1932 was named managing engineer of the panel and equipment division serving in that capacity until 1940 when he was named assistant to the manager. Mr. Paxton became manager of the Philadelphia works in 1941. **L. E. Underwood** (A '03, M '13) former manager of the Pittsfield apparatus works, has retired. Mr. Underwood was graduated from the Sheffield Scientific School of Yale University in 1896 and, after $1^1/_2$ years with the Brainard Milling Machine Company, entered the stationary motor engineering department of the General Electric Company, Lynn, Mass., in 1899. In 1915 Mr. Underwood was made chief engineer, and in 1927 he was appointed managing engineer of the consolidated motor department in charge of engineering and manufacturing. He became manager of the Pittsfield works in 1932.

Constantine Bary (A '25, M '43) rate research engineer, Philadelphia (Pa.) Electric Company, has been awarded the AIEE Philadelphia Section best initial paper prize for the year 1945–46 for the paper on "Coincidence Factor Relationships of Electric-Service-Load Characteristics" (*AIEE Trans, vol 64, 1946, Sept sect, pp 623–9*). Born December 26, 1903, in St. Petersburg, Russia, Mr. Bary was graduated from the Massachusetts Institute of Technology in 1927 with the degree of bachelor of science in electrical engineering. Since 1922 he has been associated continuously with the Philadelphia Electric Company, Philadelphia, Pa. During World War II he served as consultant to the Office of Production Management, as chief of power requirements and forecasts of the War Production Board, as consulting power engineer of the Office of War Utilities, and as consultant on the staff of the Technical Industrial Disarmament Committee for the German electric power industry under the auspices of the Foreign Economic Administration.

C. E. Stryker (A '21, F '35) formerly vice-president and assistant to the president, Nordberg Manufacturing Company, Milwaukee, Wis., has been elected president and general manager of Adel Precision Corporation, Burbank, Calif. Mr. Stryker holds the degrees of bachelor of science in electrical engineering (1917) and electrical engineer (1924) from the Armour Institute. He commenced his career in Chicago, Ill., where he was testing engineer for the Commonwealth Edison Company in 1917, engineer and purchasing agent for the Ozone Pure Airifier Company in 1919, and assistant engineer for the Underwriters Laboratories in 1922. In 1923 he was named electrical engineer by Fansteel Products Company, Inc., North Chicago. He subsequently became manager of the industrial division, vice-president and general manager of the Ramet Corporation of America, a Fansteel subsidiary, and chief engineer of the Fansteel company. He joined the firm of McKinsey, Kearney and Company in 1933 and became a partner in 1938. He has been associated with the Nordberg company since 1940. Mr. Stryker is a member of the Society of Automotive Engineers, the American Society of Naval Engineers, the Engineers' Society of Milwaukee, and the Newcomen Society. From 1920 to 1924 he was assistant professor of electrical engineering at the Armour Institute.

W. J. Shackleton (A '12) development engineer, Bell Telephone Laboratories, Inc., New York, N. Y., has retired. Mr. Shackleton was graduated from the University of Michigan with the degree of bachelor of science in 1909 and immediately joined the Western Electric Company, Hawthorne, Ill. He was transferred to the physical laboratory in New York in 1910 as development engineer and continued with Bell Laboratories when they were established in 1925. In 1928 he was appointed transmission apparatus engineer. His studies in the application of magnetic materials and refinements in the art of precision electrical measurements of impedance, time, and frequency have had nation-wide recognition. During World War II, he had charge of important projects for the United States Navy concerning the development of magnetic devices for various applications, including the detection of submerged magnetic bodies. He also was appointed a consultant by the National Defense Research Council. Mr. Shackleton has served on committees of the American Society for Testing Materials and the American Standards Association.

J. K. Johnson (A '28) formerly executive engineer, Hammarlund Manufacturing Company, New York, N. Y., has opened an office for radio and electronic engineering consulting services in New York. He received the degree of electrical engineer from Columbia University in 1927 and was an instructor in physics at Mechanics Institute, New York, from 1925 to 1929 and an instructor in electrical engineering at Columbia University in 1928 and 1929. Dur-

ing the latter years he was chief research engineer for the Pacent Electrical Corporation, New York, and was assistant chief engineer for Silver-Marshall, Chicago, Ill., in 1929 and 1930. He was an engineer with the Hazeltine Corporation, New York, from 1930 until in 1934 he returned to Chicago as chief engineer of the Wells Gardner Company. He took charge of the Chicago laboratory of the Hazeltine Service Corporation in 1937. He was named chief of production section, electronics division, Office of the Secretary of the Navy, Washington, D. C., in 1943 and joined the Hammarlund company in 1944.

J. D. Mamarchev (M '45) formerly chief engineer, The Austin Company's Freeport, Tex., office, has organized the consulting firm of James D. Mamarchev and Associates, Houston, Tex. Mr. Mamarchev holds degrees from the Sofia State Lyceum, Sofia Military College, the University of Manchester, and Columbia University. From 1923 to 1933 he was assistant electrical engineer with Gibbs and Hill, Inc., New York, N. Y., and in 1934 became electrical engineer for the Radio Corporation of America in London, England. He was engineer in charge of the New York office of the Steinholz Engineering Company from 1935 to 1937 and for the following two years was associated with the construction of the LaGuardia Municipal Airport in New York as assistant chief and chief electrical engineer. From 1940 to 1944 he was associated for brief periods with the United States Engineers' Corporation; Robert and Company, Atlanta, Ga.; Basic Magnesium, Inc., Las Vegas, Nev.; Donald R. Warren Company, Los Angeles, Calif.; and the United States Navy Yard, Mare Island, Calif. In 1944 he joined the Austin company.

M. H. Pratt (M '34) formerly electrical engineer, engineering department, Central New York Power Corporation, Syracuse, has been appointed chief engineer of the corporation. Mr. Pratt entered the employ of the Niagara Hudson system as a cadet engineer with the Syracuse Lighting Company in 1926, the year he was graduated from the University of Pennsylvania. In 1927 he was first assistant to the distribution engineer and then assistant distribution engineer, and in 1928 assistant engineer and then engineer of the electrical department. He was appointed assistant division engineer for the central division of the Niagara Hudson system in 1931 and division engineer in 1932. When the Central New York Power Corporation was formed in 1937, he became electrical engineer. He is a member of Sigma Xi and Tau Beta Pi.

W. V. B. Van Dyck (A '01, M '31) assistant to the president, International General Electric Company, Schenectady, N. Y., has retired. Mr. Van Dyck holds the degrees of bachelor of science and master of science from Rutgers College and electrical engineer from Columbia University. From 1897 to 1899 he was employed by the American Luxfer Prism Company, Chicago, Ill., and for one year afterwards was instructor at Rutgers College, New Brunswick, N. J. After a period as a consulting engineer he worked for W. R. Grace and Company in Valparaiso and Santiago, Chile, from 1907 to 1911. In 1911 he joined the General Electric Company in Rio de Janeiro, Brazil, becoming managing director and president of the South American company. He was appointed manager of the International General Electric Company's Schenectady office in 1927 and assistant to the president in 1937.

J. S. Moulton (A '22, M '27) formerly commander, Civil Engineer Corps, United States Naval Reserve, Berkeley, Calif., has been named executive engineer of the Pacific Gas and Electric Company, San Francisco, Calif. Mr. Moulton was graduated from Sheffield Scientific School of Yale University in 1920, and entered the operating department of the San Joaquin (Calif.) Light and Power Company. Following that he joined the Great Western Power Company, becoming executive engineer in 1929, and, when in 1930 that company merged with the Pacific Gas and Electric Company, he was made assistant to the vice-president and general manager. In 1940 he was transferred to the executive engineer's department. He entered the Navy in 1942 as a lieutenant commander.

Paul Crago (A '44) formerly railroad representative, general commercial department, Federal Telephone and Radio Corporation, Newark, N. J., will be supervisor of the new New York, N. Y., branch laboratory of the Wilmotte Laboratory, Inc., Washington, D. C. Mr. Crago previously was associated with the Union Switch and Signal Company, and Specialties, Inc. **G. C. Engel** (A '41) formerly production manager of General Electronics, Inc., and manager of the laboratory of General Time Instruments Corporation, New York, will head a group specializing in electronic controls and inspection methods. Mr. Engel was graduated from Stevens Institute of Technology in 1927.

F. L. Nason (A '43) formerly New England district manager, Westinghouse Electric Corporation, Boston, Mass., has been made a special representative of the company in the New England district. Mr. Nason joined the Westinghouse corporation in 1914, was made central station sales manager in 1921, and district sales manager in 1938. He recently was elected president of the Electric Institute of Boston. **F. S. Bacon** (A '37, M '44) formerly assistant manager of the central station division for the district, has been made central station manager. Mr. Bacon was graduated from Northeastern University and joined the Westinghouse corporation in 1936. He has been assistant manager since 1941.

W. S. Gifford (A '16) president, American Telephone and Telegraph Company, New York, N. Y., has been awarded the Medal for Merit of the United States. The citation accompanying the award states that Mr. Gifford "made every effort to assure that the facilities of his organization were utilized to the maximum extent possible in the successful prosecution of the war. Under his direction and leadership radio teletypewriter systems were developed. . . . Not only did Mr. Gifford place the technical facilities of his company at the disposal of the Army, but he directed it in playing a major role in furnishing highly trained technical specialists to the Army through the affiliated plan."

J. C. Arnell (A '28) formerly manager, personnel co-ordination bureau, Consolidated Edison Company of New York (N. Y.), Inc., has been appointed senior assistant personnel director.

H. F. Lowe (A '33) formerly chief of the materials control section of the Office of War Utilities, Washington, D. C., has become a partner in the firm of Sloan and Cook, Chicago, Ill.

R. C. Mildner (A '34) formerly squadron leader in the Royal Air Force, has joined the technical staff of the Telegraph Construction and Maintenance Company, Ltd., England.

Llewellyn Evans (A '07, F '41) chief consulting engineer, Tennessee Valley Authority, Chattanooga, Tenn., has been loaned to the War Department and will be sent to Austria to assist the government on problems of power generation and distribution.

A. G. L. McNaughton (A '11, HM '42) former commander in chief of the Canadian Army and later Minister for National Defense, has been appointed Canadian representative on the United Nations' Atomic Energy Commission.

F. H. Ferguson (A '34, M '42) power and light superintendent, Bremerton (Wash.) division of the Puget Sound Power and Light Company, has been transferred to the central division, Seattle.

C. W. Kellogg (A '19, M '23) president of the Edison Electric Institute, New York, N. Y., will retire June 30. Mr. Kellogg has held his present position since 1939.

C. O. Jett (A '42, M '44) formerly radar engineer, United States War Department, Washington, D. C., has been appointed system telegraph and telephone engineer for the Union Pacific Railroad, Omaha, Nebr. Mr. Jett attended the University of Kentucky, Eastern Kentucky State Teachers' College, and George Washington University. Before the war he was associated with the Bell Telephone System, the United States Forest Service, and the Tennessee Valley Authority.

W. B. Bedell (A '35, M '35) has returned to the long lines engineering department of the American Telephone and Telegraph Company, in New York, N. Y., after having served as district engineer of the long lines plant department in Chicago, Ill., since 1940. Mr. Bedell entered the employ of the American Telephone and Telegraph Company in the long lines department in 1919 after short periods with the General Electric Company, Schenectady, N. Y.; the B. F. Goodrich Rubber Company, Akron, Ohio; and the Truscon Steel Company, Youngstown, Ohio.

J. E. Smith (A '39) formerly senior research engineer, terminal facilities department, RCA Laboratories, Radio Corporation of America, New York, N. Y., has become head of the microwave communication engineering department of the Raytheon Manufacturing Company, Waltham, Mass. Mr. Smith is a graduate of Jamestown College and received the degree of master of electrical engineering from California Institute of Technology in 1933. He joined the Radio Corporation of America in 1934 as student engineer and was instructor in the RCA Institute for four years and a graduate lecturer at New York University for three. In 1938 he became engineer in the central office laboratory. At present he is adjunct professor at the university. He is a member of the Institute of Radio Engineers.

D. L. Jaffe (A '36) formerly chief research engineer, Templetone Radio Company, Mystic, Conn., has joined the Polarad Electronics Company, New York, N. Y., as a partner and general manager. Doctor Jaffe received the degrees of bachelor of science from the College of the City of New York in 1935, master of science in 1936, and doctor of philosophy from Columbia University in 1940. From 1937 to 1939 he was occupied with research in frequency modulation at Columbia University, New York, and in 1939 became television engineer for the Columbia Broadcasting System. He was appointed development engineer in the microwave radar division of the Raytheon Manufacturing Corporation, Waltham, Mass., in 1942 and in 1944 joined the staff of the Templetone company. He also is a member of Sigma Xi and the Institute of Radio Engineers.

A. A. Sylvane (A '35, M '42) formerly chief engineer, Commercial Radio and Sound Corporation, New York, N. Y., is now chief engineer of Continental Electronics, Ltd., New York. Mr. Sylvane, who was born in Brooklyn, N. Y., in 1913, was graduated from the College of the City of New York with the degree of bachelor of science in 1934 and in 1935 received the degree of electrical engineer. He has been associated with the Commercial Radio corporation since 1935 designing and engineering large centralized sound and public address systems and special systems for teaching the hard of hearing. During 1939 and 1940 Mr. Sylvane was in charge of all communication and public address work at the New York World's Fair.

C. E. Egeler (M '41) captain in the United States Naval Reserve, has returned to the engineering division of the General Electric Company, Cleveland, Ohio. Since his return he has been assigned to federal government lighting activities and research on industrial applications of infrared applications. Captain Egeler, who also served in World War I, was called to active duty as a lieutenant commander in 1941. He served as resident inspector of Navy material and director of the Munhall Navy Laboratory in the Pittsburgh district and as head of the Naval Inspection Service in the Pittsburgh area.

W. M. Adler (A '25, M '44) engineer on war leave of absence from the Consolidated Edison Company of New York (N. Y.), Inc., has resigned as electrical engineer of the repairs and utilities section, military construction division, Office of the Chief of Engineers, Washington, D. C., to return to the Edison company. Mr. Adler left the company in 1942 to become electrical engineer for the National Housing Administration's Fairlington project in Arlington, Va. When this was completed in 1944, he joined the Office of the Chief of Engineers.

E. I. Pease (A '21, M '29) formerly principal engineer, Civil Works Branch, United States Engineering Office, Seattle, Wash., has been appointed head of the engineering division of the Seattle District of the United States Army Engineers. Mr. Pease has been with the United States office since he was graduated from the University of Washington in 1912. Since 1928 he has served in executive capacities connected with comprehensive surveys of regional water resources, improvement of waterways and harbors, and projects for flood control.

C. S. Lumley (A '23, F '45) formerly industrial engineering manager and chief industrial engineer, Smith, Hinchman, and Grylls, Inc., engineers and architects, Detroit, Mich., and New York, N. Y., has been made industrial division manager of the company. Mr. Lumley first became associated with the company in 1925 as electrical engineer. From 1940 to 1944 he was with the Roller-Smith Company, Bethlehem, Pa., as district engineer and later general manager, returning to the Detroit office of Smith, Hinchman, and Grylls in 1944 as industrial engineering manager.

L. L. Glezen (A '22, M '29) telephone engineer, Bell Telephone Laboratories, Inc., New York, N. Y., has been awarded the Bronze Star Medal for outstanding service in support of combat troops. Mr. Glezen was a technical observer for the Signal Corps in England and on the continent. He was commended for working for periods of 24 to 36 hours of his own volition in order to restore French telephone facilities for military use in the crucial days of the Normandy invasion and after the liberation of Paris.

Morton Sultzer (A '13, M '34) until recently on leave of absence from Bell Telephone Laboratories, Inc., New York, N. Y., and colonel, United States Signal Corps, has been awarded the Legion of Merit. Colonel Sultzer has served as chief of the Stock Control Division, Storage and Issue Agency and as commanding officer of the Sacramento Signal Depot. Colonel Sultzer was commended for innovations which greatly reduced the processing time required for requisitions for equipment from United States troops.

J. W. Koch (A '35) formerly captain, United States Army, has joined the engineering staff of the Mutual Broadcasting System. Since 1942 he served variously as technical adviser of the Radio Propaganda Unit, staff radio officer at Allied Force Headquarters in North Africa and Italy, and in the office of the Chief Signal Officer in Baltimore, Md. Mr. Koch, a 1934 graduate of the University of Nebraska, previously had been associated with station KFEQ, St. Louis, Mo.

Joseph Bronaugh (A '29, M '37) formerly sales representative, Allis-Chalmers Manufacturing Company, Richmond, Va., has been appointed manager of the company's newly established branch office in Miami, Fla. A 1927 graduate of the University of Virginia, Mr. Bronaugh joined the Allis-Chalmers company in 1929. During World War II he served as a lieutenant in the United States Naval Reserve for 31 months.

T. W. Eadie (A '27) general plant manager, Bell Telephone Company of Canada, Toronto, Ontario, has been transferred to Montreal, Quebec, as assistant vice-president. Mr. Eadie joined the company after his graduation from McGill University in 1923. He became toll and transmission engineer in 1927, division plant engineer in 1929, and outside plant engineer in 1930. In 1936 he was made general plant superintendent, and general plant manager in 1939.

D. S. Smith (A '33) wartime power research engineer, physics and electrical engineering department, National Research Council, Ottawa, Ontario, Canada, has rejoined the Northern Electric Company as power apparatus sales engineer in the company's Vancouver, British Columbia, office. Mr. Smith is a graduate of the University of British Columbia and has been with the Northern Electric Company since 1936.

W. L. Mann (A '03) division manager, Metropolitan Edison Company, York, Pa., has retired. Mr. Mann received the degrees of bachelor of science from Virginia Polytechnic Institute in 1901 and mechanical engineer from Cornell University in 1903. He became general manager of the York Haven (Pa.) Water and Power Company in 1911 and continued as local manager when the company was purchased by the Metropolitan Edison Company in 1923. In 1926 he was made division manager.

G. E. Snider (A '17, F '39) formerly vice-president and general distribution engineer, Ohio Public Service Company, Cleveland, has been named vice-president in charge of operations for the company. Mr. Snider started his career in 1905 with the Toledo Railway and Light Company, continuing with design and construction work when this company became the Toledo Edison Company. In 1922 he joined the Ohio Public Service Company as general distribution engineer, and as such he designed the company's 132-kv transmission system. In 1927 he organized the company's safety program and in 1941 was appointed vice-president.

C. E. Hastings (A '36, M '43) formerly physicist, research department, National Advisory Committee for Aeronautics, Langley Field, Va., has been appointed chief engineer, Hastings Instrument Company, Hampton, Va. Mr. Hastings received a bachelor of engineering degree from Johns Hopkins University in 1935 and engaged in advance study at the University of Virginia. During the war he taught in the University of Virginia Extension Division. He had been with the National Advisory Committee for the past ten years.

W. W. Satterlee (A '23, M '41) division engineer in the small power and network division, Westinghouse Electric Corporation, Sharon, Pa., and **Saul Bennon** (A '38) project engineer in the Sharon plant, have been awarded the Westinghouse Order of Merit. Mr. Satterlee was cited for his ability in developing and marketing the ASL dry type power transformer, and Mr. Bennon for his part in the design, development, and manufacture of a new electric torpedo.

I. G. Easton (A '41) engineer, General Radio Company, Cambridge, Mass., has been appointed manager of the company's New York, N. Y., engineering and sales office. Mr. Easton holds degrees from Northeastern and Harvard Universities and has been with the General Radio Company since 1939. He also taught wartime courses in radio engineering at Northeastern University.

A. W. Walton (A '39, M '45) protective engineer, relay department, Oklahoma Gas and Electric Company, Oklahoma City, has been appointed electrical engineer, generation department. Mr. Walton joined the company in 1928 and has been protective engineer since 1935. **G. E. Brooks** (A '41) formerly relay engineer, succeeds Mr. Walton as protective engineer. Mr. Brooks has been with the company since 1935.

R. S. Plotz (A '38, M '45) formerly member of the technical staff, Bell Telephone Laboratories, Inc., New York, N. Y., has been appointed assistant to vice-president. Mr. Plotz, a graduate of the University of Wisconsin, joined the laboratories in 1930.

F. M. Tait (A '94, F '12) president and general manager, Dayton (Ohio) Power and Light Company, has resigned from these two offices but will remain as chairman of the board of the company. Mr. Tait, who was born in Catasauqua, Pa., in 1874, was associated early in his career with the Catasauqua Electric Light and Power Company, the Somerset Lighting Company in New Jersey and the New London (Conn.) Gas and Electric Company. He joined the Dayton Electric Light Company, predecessor of the Dayton Power and Light Company, in 1905 as manager and director.

R. D. Bennett (F '35) captain, United States Naval Reserve, and director of technical development, Naval Ordnance Laboratory, Washington, D. C., recently was presented with the Legion of Merit in recognition of his services at the laboratory since 1940. The citation lauds his "thorough knowledge of theoretical and applied sciences . . . his administrative ability in the field. . . . His discerning efforts in the fulfillment of an assignment vital to the successful prosecution of the war. . . ." The British Government recently made Captain Bennett an Honorary Officer of the Military Division of the Most Excellent Order of the British Empire.

H. C. Madsen (A '42) manager, university relations, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been appointed manager of industrial relations, Bryant Electric Company, Bridgeport, Conn. Mr. Madsen previously was connected with the Philco Radio and Television Corporation, Philadelphia, Pa.

Reinhold Rüdenberg (M '38) Gordon McKay professor of electrical engineering, Harvard University Graduate School of Engineering, Cambridge, Mass., recently received one of the three Honor Awards of the Alumni Association of Stevens Institute "for notable achievement in the field of electron optics, as the inventer of the electron microscope."

C. L. Johnson (A '46) member of the sales staff in the Dugas office, Chicago, Ill., of the Ansul Chemical Company, has been appointed manager of that office. Mr. Johnson previously had been connected with the Sherwin-Williams Company, the La Salle Steel Company, and the Republic Steel Corporation.

A. R. Stevenson, Jr. (A '20, F '37) vice-president in charge of engineering policy, General Electric Company, Schenectady, N. Y., recently received the honorary degree of doctor of engineering from Stevens Institute of Technology.

G. H. Bucher (M '24) who recently resigned as president of the Westinghouse Electric Corporation, Pittsburgh, Pa., has been elected vice-chairman of the board of directors of the company.

W. C. Morrison (A '44) formerly supervisor of the electrical operations department for the Carbide and Carbon Chemical Corporation, at the atomic bomb project, Oak Ridge, Tenn., has joined the staff of the industrial engineering department of the Iowa–Illinois Gas and Electric Company, Moline, Ill. Mr. Morrison was graduated from the University of Iowa in 1942 and previously was associated with the General Electric Company, Schenectady, N. Y.

G. G. Jones (M '35) formerly general plant superintendent of the central area, long lines department, American Telephone and Telegraph Company, is now general plant superintendent of the Eastern area. **R. H. Ross** (M '25, F '43) division plant superintendent, long lines department, Philadelphia, Pa., has been appointed general plant superintendent of the central area.

V. E. Schlossberg (A '29, M '35) assistant superintendent of electric and power departments, Inland Steel Company, East Chicago, Ind., has been elected a director of the Association of Iron and Steel Engineers. Mr. Schlossberg was a member of the technical group which went to Germany in 1945 to investigate the steel industry.

J. E. Underhill (A '29, M '37) formerly lieutenant colonel, assistant director of research, Royal Canadian Artillery, Canadian Active Service Forces, Ottawa, Ontario, has returned to the British Columbia Electric Railway Company, Vancouver, and has been appointed director of the industrial development department. Mr. Underhill had been with the company from 1927 until he entered military service in 1940. Early in his career Mr. Underhill was associated with the Canadian Westinghouse Company, as well as with the Westinghouse Electric Corporation, Pittsburgh, Pa.

H. S. Osborne (A '10, F '21) chief engineer, American Telephone and Telegraph Company, New York, N. Y., recently was awarded a fellowship in the Institute of Radio Engineers for his "contributions in the electrical communication field including outstanding leadership and direction in the application of new techniques to telephony."

W. A. Perry (M '38) formerly superintendent of the electrical and power departments, Inland Steel Company, East Chicago, Ind., has been made assistant to the general superintendent of the company. Mr. Perry has been with the company since 1910 and is a past president of the Association of Iron and Steel Engineers.

L. R. Milburn (A '20, F '39) electrical engineer, Great Lakes Steel Corporation, Ecorse, Mich., has been elected first vice-president of the Association of Iron and Steel Engineers.

G. V. Harrap (A '34, M '43) formerly deputy city electrical engineer of Norwich, Norfolk, England, has been appointed borough electrical engineer and manager by the Council of Gravesend, Kent. Mr. Harrap previously was associated with the West Ham, Hill, and Dundee Electricity Departments, the North-Eastern Electricity Supply Company, Ltd., and the Metropolitan-Vickers Electrical Company, Ltd.

C. E. Dreher (A '43) regional director of Brazil, Westinghouse Electric International Company, Rio de Janiero, has been awarded the Westinghouse Order of Merit "for outstanding performance in the establishment and expansion of the company's business performance in foreign territory under exceptional circumstances."

R. H. Mecklenborg, Jr. (A '42) recently lieutenant in the Army Signal Corps, has returned from two years of European service to resume his former position of instrumentation specialist with the Automatic Temperature Control Company, Inc., Philadelphia, Pa. He is a graduate of Drexel Institute of Technology.

J. H. Blankenbuehler (A '31, M '40) section engineer, welding engineering department, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been made manager of arc welding apparatus for the corporation. Mr. Blankenbuehler was graduated from Lehigh University in 1923 and has been with the Westinghouse corporation since.

Vance Oathout (A '30) chief engineer, Indiana Bell Telephone Company, Indianapolis, has retired. Mr. Oathout was born in Luana, Iowa, in 1881. He entered the employ of the Bell Telephone System in 1903 and spent his entire engineering career with the company. From his first position of groundman he advanced to lineman, foreman, wire chief, exchange manager, traffic superintendent, plant extension engineer, and finally to chief engineer.

R. W. Gemmell (M '43) formerly manager of the aviation section, industrial engineering department, Westinghouse Electric Corporation, East Pittsburgh, Pa., has become manager of the corporation's aircraft sales department, Lima, Ohio. Mr. Gemmell was graduated from the University of Minnesota in 1926, the year he joined the Westinghouse corporation. He has been working on aviation problems since 1936.

J. C. Henkle (M '36) formerly assistant general superintendent, Portland (Oreg.) General Electric Company, has been appointed general superintendent. Mr. Henkle, who has been with the company 37 years, commenced his career as a wireman, later becoming foreman and superintendent of electrical maintenance and construction. He has been assistant general superintendent since 1943.

J. H. Cox (A '25) formerly section engineer, mercury arc rectifier engineering department, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been appointed engineering manager for the Pacific Coast manufacturing and repair division headquarters, Emeryville, Calif. Mr. Cox joined the Westinghouse corporation in 1923 as service engineer and has been section manager since 1930.

Maurice Holland (A '23, M '30) industrial research adviser, New York, N. Y., has been named director of the Scandinavian Industrial Survey, which will provide for a group of American leaders to visit Scandinavia. The Survey is the outgrowth of an invitation from **E. E. Velander** (A '18, M '44) director, Royal Swedish Institute for Scientific Engineering Research, Stockholm. Mr. Holland recently was elected first honorary fellow of the Industrial Research Institute, Inc.

Gerard Swope (A '99, F '22) honorary president, General Electric Company, Schenectady, N. Y., recently received the gold medal award of the American Society for Metals for his accomplishments in promoting research for the increased use of metals.

OBITUARY • • • •

Samuel Bingham Hood (M '14) development and research engineer, San Leandro, Calif., died March 9, 1946. Mr. Hood was born in Philadelphia, Pa., July 12, 1875. After a brief period as an independent contractor, Mr. Hood was associated early in his career with the Berliner Gramaphone Company; the Diamond Electric Light Company, Philadelphia; the Egg Harbor Electric Light and Power Company and the Gloucester County Electric Company, both in New Jersey; and the Powelton Electric Company in Pennsylvania. From 1900 to 1906 he was with the Philadelphia Electric Company as station lineman, district superintendent of construction, and assistant engineer of distribution and construction. After a two-year period as an electrical contractor, he joined the Toronto Electric Light Company, Ltd., Ontario, Canada, as distribution engineer, later becoming superintendent of distribution. In 1917 he became associated with the Northern States Power Company, Minneapolis, Minn., as distribution engineer and in 1918 was made superintendent of distribution. He retired in 1927 as consulting engineer to the company. Since that time he was retained as a consultant by The James R. Kearney Corporation, St. Louis, Mo. He was the author of articles appearing in *Electrical World*.

Kiron Chandra Roy (A '31) managing director, Oriental Mercantile Company, Ltd., and technical director, Bengal Electric Lamp Works, Ltd., both of Calcutta, India, died October 19, 1945. Mr. Roy was born December 23, 1903, in Narayanganj, Dacca, Bengal, was graduated from Bengal Technical Institute in 1926, and received the degree of bachelor of science from Massachusetts Institute of Technology in 1929. For a period he was testman with the General Electric Company, Lynn, Mass. In 1935 he was appointed sales manager for the Bengal Electric Lamp Works, Ltd., Calcutta, and in 1938 managing director of the Oriental company. He assumed the additional duties of technical director of the Bengal Lamp company in 1939. Since 1941 he had been executive head of the College of Engineering and Technology, Bengal. He served as a member of the Electric Licensing Board of the Government of India and on several panels of its Planning and Development Department. Since 1943 he had been chairman of the electric lamp manufacturers' advisory panel to the Director General of Munition Production.

Norman Allen Rollins (M '27, F '40) retired staff engineer, Commonwealth Edison Company, Chicago, Ill., died February 6, 1946, in Manchester, N. H. Mr. Rollins was born in Portsmouth, N. H., March 6, 1878, and was graduated from New Hampshire College in 1901. After completing the student course at the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., he commenced his association with the Commonwealth Edison Company in 1904 as design engineer. In 1906 he was given supervision of architects and contractors on installation work and in 1916 was named engineer in charge of electrical design. From 1917 to 1932 he supervised the installation of large industrial substations and in 1932 was titled plant installation engineer. He retired in 1944 as staff engineer.

MEMBERSHIP • •

Recommended for Transfer

The board of examiners, at its meeting of April 18, 1946, recommended the following members for transfer to the grade of membership indicated. Any objections to these transfers should be filed at once with the secretary of the Institute.

To Grade of Fellow

Bennett, R. S., chief elec. engr., T. Firth, J. Brown, Ltd., Sheffield, England
Garman, C. P., chief elec. engr., deputy gen. mgr., power system, Dept. of Water & Pr., City of Los Angeles, Calif.
Harte, C. R., engr., Connecticut Co., New Haven, Conn.
Lee, C., prof. of elec. engg., Virginia Polytechnic Institute, Blacksburg, Va.
McCreary, H. J., electronics engr., Automatic Elec. Co., Chicago, Ill.
West, G. B., chief engr., Illinois Bell Telephone Co., Chicago, Ill.

6 to grade of Fellow

To Grade of Member

Barber, C. D., primary meter man, Oklahoma Gas & Elec. Co., Enid, Okla.
Behn, E. R., senior engr., U. S. Navy Dept., Bureau of Ordnance, Washington, D. C.

Davis, D. W., Comdr., USNR, instructor in elec. engg., radio & electronics, U. S. Naval Academy, Annapolis, Md.
Diefenbach, L. T., starting engr., sr. grade, Commonwealth Edison Co., Chicago, Ill.
Dingle, R. L., elec. engr., Air Technical Service Command, AAF, Wright Field, Dayton, Ohio
Dunlap, L. B., engr., Southwestern Bell Telephone Co., Dallas, Tex.
Dyche, H. E., Jr., engr., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Farris, W. A., elec. engr., U. S. Engineer Office, Cincinnati, Ohio
Fritschel, P. G., supervisor of field engg., test & inspection, General Elec. Co., Syracuse, N. Y.
Gamey, W. A., application engr., Westinghouse Elec. International Co., New York, N. Y.
Hansen, E. L., maintenance engr., Community Public Service Co., Fort Worth, Tex.
Heumann, G. W., engr., General Elec. Co., Schenectady, N. Y.
Hodgson, A. O., sr. elec. engr., U. S. Naval Dry Dock, So. Boston, Mass.
Holmgren, E. L., dev. engr., Kuhlman Elec. Co., Bay City, Mich.
Kanouse, E. L., trans. system engr., Dept. of Water & Pr., City of Los Angeles, Calif.
Kearns, J. J., jr. maint. engr., N.Y.C. Board of Transportation, New York, N. Y.
Laughlin, J. D., sr. elec. engr., Dept. of Water & Pr., City of Los Angeles, Calif.
Mattingly, R. L., Bell Telephone Labs., Inc., Whippany, N. J.
McNary, C. V., elec. testing engr., Commonwealth Edison Co., Pekin, Ill.
Nesmith, J., 2nd, engr., Public Service Elec. & Gas Co., Newark, N. J.
Neubauer, J. P., acting div. engr., Consolidated Edison Co. of New York, Inc., New York, N. Y.
Osterberg, E. T., sr. engr. Illinois Bell Telephone Co., Chicago, Ill.
Palmer, R. J., field engr., Municipal Lighting, Detroit Edison Co., Detroit, Mich.
Peek, H. L., engr., Allis-Chalmers Mfg. Co., Boston, Mass.
Perry, F. R., research engr., Metropolitan-Vickers Elec. Co., Ltd., Manchester, England.
Pfeifer, H. P., factory representative, Allis-Chalmers Mfg. Co., El Salvador, C. A.
Randall, E. W., Jr., in charge, elec. dept., Du Pont Experiment Station, Wilmington, Del.
Russ, J. C., designing engr., General Elec. Co., Pittsfield, Mass.
Silvius, W. P., design engr., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Spaulding, J. G., treasurer, Spaulding Elec. Co., Detroit, Mich.
Trbovich, N., chief test engr., Inland Steel Co., East Chicago, Ind.
Viller, F. B., engr., western div., Gould Storage Battery Corp., Los Angeles, Calif.
Watkins, B. O., head, operating problems unit, Rural Electrification Adm., Washington, D. C.
Weber, V. D., engr., Oklahoma Gas & Elec. Co., Enid, Okla.
White, C. H., Major, Electricity Supply Dept., Singapore, S. S.
Wyman, B. W., section leader of engg., General Elec. Co., Philadelphia, Pa.
Zimmerman, E. E., project engr., Chrysler Corp., Detroit, Mich.

37 to grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Any member objecting to the election of any of these candidates should so inform the secretary before June 15, 1946, or August 15, 1946, if the applicant resides outside of the United States or Canada.

To Grade of Member

Ainsworth, C. D. (Re-election), Allis-Chalmers Mfg. Co., Hyde Park, Mass.
Beals, A. T., Advance Elec. & Relay Co., Los Angeles, Calif.
Bell, G. A., The Hydro-Elec. Power Comm. of Ontario, Toronto, Ont., Canada
Bishop, E. A., Commonwealth Edison Co., Chicago, Ill.
Boltz, H. A., The Detroit Edison Co., Detroit, Mich.
Campani, L. M., The Liquidometer Corp., Long Island City, N. Y.
Cargill, R. E., Gulf States Utilities Co., Beaumont, Tex.
Chopra, M. L., The Rawalpindi Elec. Power Co., Ltd., Rawalpindi, India
Christlieb, A. R., Public Service Co. of N. H., Manchester, N. H.
Couch, R. L., U. S. Engineers, San Francisco, Calif.
Erdelyi, E., F/L., RAFVR, Royal Aircraft Establishment, Farnborough, England
Ghose, K. K., Balrampur Raj Elec. Supply Dept., Gonda, U. P., India
Glaza, F. S., The Dow Chemical Co., Freeport, Tex.
Hartle, W. G., General Elec. Company, Philadelphia, Pa.
Hill, J. W., C. T. Gibbs, Consulting Engineer, Los Angeles, Calif.
Hissom, P. M., American Cyanamid & Chemical Corp., Bridgeville, Pa.
Hoffman, E. R., City of Seattle, Seattle, Wash.
Hoffmann, H. W., American Cable and Radio Corp., New York, N. Y.
Hughes, D. F., Potomac Elec. Power Co., Washington, D. C.
Iyengar, K. R. R., M/S Kaycee Industries, Ltd., Lahore, India
Jernigan, P. I., Laramore & Douglass, Inc., Chicago, Ill.
Johnson, F. B., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Kagalwala, A., 69 West 38th Street, New York, N. Y.
Kazar, D. E., Kiefer Elec. Supply Co., Peoria, Ill.
Keck, A., Sperry Gyroscope Co., Inc., Garden City, L. I., N. Y.
Knopf, K. K., Oliver B. Lyman, Mfgrs. Representative, San Francisco, Calif.
Krasin, K. A., Chicago Bridge and Iron Co., Chicago, Ill.
Kundts, R. H., Community Public Service Co., Ft. Worth, Tex.
Lamperty, L., Creole Petroleum Corp., Maracaibo, Venezuela, S. A.
Latham, F. A., City of Los Angeles Dept. of Water & Power, Boulder City, Nev
Lehman, C. H., Westinghouse Elec. Corp., San Antonio, Tex.
Levstik, J. A., Chicago Bridge and Iron Co., Chicago, Ill.
Livermore, W. N., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Marshall, J. A., Stanley Engineering Co., Winchester, Ill.
Maryssael, G. J. C., The Mexican Light & Power Co., Ltd., Mexico, D. F., Mex.
McDowell, H. E. (Re-election), Ebasco Services, Inc., of New York City, c/o Dallas Power & Light Co., Dallas, Tex.
Miller, H. E., General Elec. Co., Chicago, Ill.
Norton, H. A., Western Union Tel. Co., Denver, Colo.
O'Keeffe, G. W., Allis-Chalmers Mfg. Co., Hyde Park, Mass.
Parks, R., Albina Eng. & Mach. Wks., Portland, Oreg.
Pinkham, H. P., Allis-Chalmers Mfg. Co., Hyde Park, Mass.
Pulver, R. F., Minnesota Power and Light Co., Duluth, Minn.
Ramsaur, O., Penna. Power & Light Co., Allentown, Pa.
Robbins, R. G., Hubbard & Co., Pittsburgh, Pa.
Robinson, E. W., Alabama Power Co., Birmingham, Ala.
Ruby, E. C., Pennsylvania Power Co., New Castle, Pa.
Sandin, J., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Scott, R. F., Southwestern Gas & Elec. Co., Shreveport, La.
Simson, G. F., Hydro-Elec. Power Comm. of Ontario, Toronto, Ontario, Canada
Sinclair, C. G., Jr., American Tel. and Tel. Co., New York, N. Y.
Skifter, H. R., Airborne Instruments Laboratory, Inc., Mineola, N. Y.
Smith, S. R., Jr., General Elec. Co., Pittsfield, Mass.
Smith, W. M., Consumers Power Co., Jackson, Mich.
Stevens, J. B., Chevrolet Gear & Axle, Detroit, Mich.
Stewart, E. D., U. S. Navy Dept., Portland, Oreg.
Stubbs, S. R., Allis-Chalmers Mfg. Co., Hyde Park, Mass.
Sursaw, C. A., Tennessee Eastman Corp., Oak Ridge, Tenn.
Swanson, O. J., U. S. Coal and Coke Company, Gary, W. Va.
Ward, M., The Hydro-Elec. Power Comm. of Ontario, Toronto, Ont., Canada
Wescott, R. H., Jr., Comdr., U. S. Navy, c/o F.P.O., New York, N. Y.
Whittaker, G. E., Chase Brass and Copper Co., Cleveland, Ohio
Williams, C. M., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Woodruff, F. E., Freese and Nichols, Fort Worth, Tex.

63 to grade of Member

To Grade of Associate

United States and Canada

1. North Eastern

Bronerwine, C., Estate of J. M. Bronerwine, Norwich, Conn.
Chigas, V., Sylvania Elec. Prod., Inc., Boston, Mass.
Childs, J. N., Jr., Lt. (jg), USNR, Naval Research Laboratory, Boston, Mass.
Clendening, H. C., U. S. Military Academy, West Point, N. Y.
DeWolf, F. T., General Elec. Co., West Lynn, Mass.
Ellms, L., Ohio Brass Co., Boston, Mass.
Finnell, W. J., American Bosch Corp., Springfield, Mass.
Gallagher, E. S., General Elec. Co., Schenectady, N. Y.
Garber, D. S., American Bosch Corp., Springfield, Mass.
Hussey, E. E., Raytheon Mfg. Co., Waltham, Mass.
Kempton, J. V., Westinghouse Elec. Corp., Boston, Mass.
Kenyon, C. H., Corning Glass Works, Corning, N. Y.
Kraft, L. M., Southern New England Tel. Co., New Haven, Conn.
Lee, E. M., General Elec. Co., Schenectady, N. Y.
Lord, R. T., New Hampshire Gas and Elec. Co., Portsmouth, N. H.
Lowell, H. T., Jr., Westinghouse Elec. Corp., Boston, Mass.
Mac Donald, K. G., General Elec. Co., Schenectady, N. Y.
McGowan, L. F. (Re-election), N. Y. State Elec. & Gas Corp., Binghamton, N. Y.
Moore, J. K., Alden Products Co., Brockton, Mass.
Mueller, F. J., Bethlehem Steel Co., Quincy, Mass.
Roberts, W. M., U. S. Navy, Naval Air Station, Squantum, Mass.
Sandblom, W. B., Navy Yard, Boston, Mass.
Schofield, M. W. (Re-election), American Woolen Co., Lawrence, Mass.
Shea, H. B., Boston Edison Co., Boston, Mass.
Stalzer, T. R., Cornell Aeronautical Lab., Buffalo, N. Y.

2. Middle Eastern

Alexander, F. L., National Carbon Co., Inc., Cleveland, Ohio
Ansley, E. V., Stackpole Carbon Co. of St. Mary's Pa., Dayton, Ohio
Ayers, D. P., Copperweld Steel Co., Glassport, Pa.
Bachelor, H. P., Westinghouse Elec. Corp., Baltimore, Md.
Birge, E. C., Virginian Elec., Inc., Charleston, W. Va.
Brightfelt, J. C., General Elec. Co., Erie, Pa.
Broemer, P. A., Westinghouse Elec. Corp., Baltimore, Md.
Brown, J. P., Lt., A. C., Air Technical Serv. Command, Wright Field, Dayton, Ohio
Cadwell, C. L., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Caplow, A. I. (Re-election), Columbia Elec. Mfg. Co., Cleveland, Ohio
Donahue, T. M., General Elec. Co., Erie, Pa.
Edmunds, R. E., Pennsylvania Power & Light Co., Hazleton, Pa.
Ewing, J. S., The Hertner Elec. Co., Cleveland, Ohio
Gandy, B. B., New York Shipbuilding Corp., Camden, N. J.
Gordy, E. M., Consolidated Gas, Elec. Lt., & Power Co., Baltimore, Md.
Hamel, R. E., Cleveland Elec. Illuminating Co., Cleveland, Ohio
Hartlove, W. B., Bethlehem-Sparrows Point Shipyard, Inc., Sparrows Point, Md.
Hill, F. A., Bureau of Ordnance, Navy Dept., Washington, D. C.
Hughes, J. F., H. A. Kuljian and Co., Philadelphia, Pa.
Ketter, G. S., B. F. Goodrich Co., Akron, Ohio
La Sota, L. S., Pennsylvania Transformer Co., Heidelberg, Pa.
Lenz, H. R., Philadelphia Elec. Co., Philadelphia, Pa.
Liston, D. S., General Elec. Co., Erie, Pa.
Loeblich, F., Westinghouse Elec. Corp., Sharon, Pa.
Meyer, G. E., Allis-Chalmers Mfg. Co., Norwood, Ohio
Molina, M. J., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Morgan, A. G., Kanawha Rail & Machinery Co., Charleston, W. Va.
Musick, G. N., Thomas A. Edison, Inc., Huntington, W. Va.
Pantis, H. J., Philadelphia Elec. Co., Philadelphia, Pa.
Parente, F. A., General Elec. Co., Dayton, Ohio
Pool, E. L., Lt. (jg), USNR, Naval Research Laboratory, Washington, D. C.
Robbins, P. H., Metropolitan Edison Co., Reading, Pa.
Schaul, M. H., Kanawha Rail & Machinery Co., Charleston, W. Va.
Shaffer, D. B., Monongahela Power Co., Parkersburg, W. Va.
Small, W. R., Jr., Pennsylvania Water & Power Co., Holtwood, Pa.
Stone, H. B. (Re-election), Robbins & Myers, Inc., Springfield, Ohio
Taborsky, S., Glenn L. Martin Co., Baltimore, Md.
Ulrikson, K. B., The Ohio Bell Tel. Co., Dayton, Ohio
Vassar, R. L., Rural Electrification Administration, Washington, D. C.
Webb, J. B., Robbins and Myers, Inc., Springfield, Ohio
Widmann, F. W., RCA Victor Div., RCA, Camden, N. J.
Wigert, J. W., Westinghouse Elec. Corp., Cleveland, Ohio
Wrobbel, W. J., Cleveland Elec. Ill. Co., Cleveland, Ohio

3. New York City

Aronoff, M., Western Elec. Co., New York, N. Y.
Backer, L. E., Stevens Institute of Technology, Hoboken, N. J.
Bayley, W. R., Public Service Elec. & Gas Co., Irvington, N. J.
Berner, J. P., Morganite Brush Co., Inc., Long Island City, N. Y.
Borjes, A., Western Elec. Co., New York, N. Y.
Caradonna, V. (Re-election), Consolidated Edison Co., New York, N. Y.
Chudow, J., New York Naval Shipyard, Brooklyn, N. Y.
Connors, W. M., Crocker-Wheeler, Ampere, N. J.
Corcoran, J. A., Consolidated Edison Co., New York, N. Y.

Dusinberre, H. W., Comdr., USNR (Re-election), Rocke Int'l. Corp., New York, N. Y.
Franklin, W. M., Phelps Dodge Copper Products Corp., Yonkers, N. Y.
Jarvis, D. M., Automatic Switch Co., New York, N. Y.
Kraus, R. D., Mack Mfg. Co., Plainfield, N. J.
Lund, N., Bell Tel. Labs., New York, N. Y.
Marts, L. W., Public Serv. Elec. & Gas Co., Newark, N. J.
McShea, W. T., Jr., The Lummus Co., New York, N. Y.
Meyer, E. R., Federal Tel. & Radio Corp., Belleville, N. J.
Muchnick, P., 2239 Creston Ave., New York, N. Y.
Primm, J. F., Continental Elec. Co., Inc., Newark, N. J.
Quinn, W. T., The American Bureau of Shipping, New York, N. Y.
Rippere, R. O. (Re-election), Bell Tel. Labs., Inc., New York, N. Y.
Roeder, H. M., Public Service Elec. & Gas Co., Newark, N. J.
Shachmut, W. C., National Lead Research Lab., Brooklyn, N. Y.
Swift, J. J., Dept. of Public Works City of N. Y., N. Y.
Weinstein, J., Crocker-Wheeler Elec. Mfg. Co., Ampere, N. J.
Witham, H. W., U. S. Rubber Company, Passaic, N. J.

4. Southern

Balch, L. C., Westinghouse Elec. Corp., Knoxville, Tenn.
Boozer, J. R., Mathieson Alkali Works, Lake Charles, La.
Bozeman, F. B., J. E. Sirrine and Co., Greenville, S. C.
Boyd, J. G., Southwestern Gas and Elec. Co., Shreveport, La.
Cogan, I., Georgia School of Technology, Atlanta, Ga.
Crawley, A. O., Bureau of Yards and Docks, Norfolk, Va.
Evans, L. L., Alabama Power Co., Birmingham, Ala.
Ford, H. G., Jr., Birmingham Elec. Co., Birmingham, Ala.
Griffith, J. A., Birmingham Elec. Co., Birmingham, Ala.
Gunn, P. L., Southwestern Gas & Elec. Co., Shreveport, La.
Lemon, F. H., Jr., Chesapeake & Potomac Tel. Co. of Va., Norfolk, Va.
Major, F. H. (Re-election), Tennessee Valley Authority, Chattanooga, Tenn.
McDowell, S. J., American Lava Corp., Chattanooga, Tenn.
Meriwether, G. M., 2226 Third Avenue North, Birmingham, Ala.
Munroe, E. E., Tennessee Valley Authority, Knoxville, Tenn.
Osborne, N. M., Jr., General Elec. Co., Norfolk, Va.
Polk, W. E., Polk Elec. Co., Shreveport, La.
Pons, C. M. L., Davis-Pons Elec. Co., Shreveport, La.
Sprowl, S. M., Jr., (Re-election) Duke Power Co., Greensboro, N. C.
Swaringen, C. T., Jr., 2211 Wright Ave., Greensboro, N. C.
Warren, J. D., Louisville Gas & Elec. Co., Louisville, Ky.
Wood, C. D., General Elec. Co., Richmond, Va.

5. Great Lakes

Aas, E. A., Farnsworth Tel. & Radio Corp., Ft. Wayne, Ind.
Ascher, G., Progressive Welder Co., Detroit, Mich.
Austin, L. E., North Dakota Agricultural College, Fargo, N. D.
Avery, C. C., General Foods Corp., Battle Creek, Mich.
Barbier, G. H., Electrical Inspection and Servicing Co., Detroit, Mich.
Bonnell, J. R., Consolidated Cement Corp., Cement City, Mich.
Brown, C. R., 329 N. Lee St., Iowa City, Iowa
Campbell, A. R., Westinghouse Elec. Corp., Chicago, Ill.
Carlson, W. R., Commonwealth Edison, Chicago, Ill.
Cogswell, C. G., Public Lighting Comm., Detroit, Mich.
Drummond, J. W., The Detroit Edison Co., Detroit, Mich.
Esau, W. A., Board of Education, Saginaw, Mich.
Frankenfield, W. A., The Detroit Edison Co., Detroit, Mich.
Gallicchio, F. V., Commonwealth Edison Co., Chicago, Ill.
Glassow, F. A., Barber-Colman Co., Rockford, Ill.
Gustafson, G. A. (Re-election), Minnesota Power and Light Co., Duluth, Minn.
Hammerstrom, A. A., Minnesota Power & Light Co., Duluth, Minn.
Holland, D. B., Cutler-Hammer, Inc., Milwaukee, Wis.
Huntzinger, G. O., Delco Remy Div., General Motors, Anderson, Ind.
Keeley, E. L., Northern Indiana Public Service Co., Hammond, Ind.
Kohler, R. W., Commonwealth Edison Co., Chicago, Ill.
Krebs, J., Jr., Western Elec. Co., Inc., Cicero, Ill.
Mayfield, W. A., Vern E. Alden, Engineers, Chicago, Ill.
McCollum, T. A., Western Elec. Co., Chicago, Ill.
Miner, C. E., Vern E. Alden, Engineers, Chicago, Ill.
Oberhausen, J. J., Commonwealth Edison Co., Chicago, Ill.
Plengey, W. D., Public Service Co. of Northern Ill., Maywood, Ill.
Pogoff, R., Capacitron Co., Chicago, Ill.
Poplett, W. R., Prewett Elec. Co., Peoria, Ill.
Preston, L. R., Commonwealth Edison Co., Chicago, Ill.
Sheffield, B. H., Commercial Solvents Corp., Peoria, Ill.
Smith, E. F., Vickers, Inc., Detroit, Mich.
Smith, P. E., Public Service Co. of No. Ill., Chicago, Ill.
Sorenson, H. (Re-election), Wisconsin Elec. Power Co., Milwaukee, Wis.
Stevenson, A. R., Dept. of Public Works, Detroit, Mich.
Stone, S. P., Public Lighting Comm., Detroit, Mich.
Toutenhoofd, W. L., Western Elec. Co., Detroit, Mich.
Valentine, R. E., Spaulding Fibre Co., Fort Wayne, Ind.
Walters, G. E., Caterpillar Tractor Co., East Peoria, Ill.
Wechsler, L., Bendix Aviation Corp., South Bend, Ind.
Wilson, G. P., Tri-State College, Angola, Ind.
Wright, J. W., Michigan Bell Tel. Co., Saginaw, Mich.
Zeller, G. A., Int'l. Business Mach. Corp., Peoria, Ill.

6. North Central

Halle, S. (Re-election), Halle Electric Co., Colorado Springs, Colo.
Post, L. A., Public Service Co. of Colorado, Denver, Colo.
Scussel, F. G., Public Service Co. of Colorado, Denver, Colo.

7. South West

Beale, W. E., Baker Engg., San Antonio, Tex.
Bourne, R. D., University of Texas, Austin, Tex.
Bowen, R. L., Community Public Service Co., Ft. Worth, Tex.
Cook, B. J., Oklahoma Gas and Elec. Co., Oklahoma City, Okla.
Covington, J. K., Freese and Nichols, Fort Worth, Tex.
Feather, A. M., Community Public Service Co., Fort Worth, Tex.
Glasco, C. E., Kansas Gas & Elec. Co., Wichita, Kan.
Hall, E. H., Kansas City Power & Light Co., Kansas City, Mo.
Hart, W. G., Public Service Co., Tulsa, Okla.
Hildebrand, W. F., General Elec. Co., Tulsa, Okla.
Hixon, J. L., General Elec. Co., Houston, Tex.
Kayser, C. S., Houston Lighting & Power, Houston, Tex.
Lee, F. N., Humble Pipe Line Co., Houston, Tex.
Liggett, W. E., Southwestern Bell Tel. Co., St. Louis, Mo.
Moll, D. E., 609 East Fifth St., Hutchinson, Kan.
Pool, J. L., Magnolia Pipe Line Co., Dallas, Tex.
Shearer, W. E., Shearer Elec. Co., Little Rock, Ark.
Sherwood, R. W., Gulf States Utilities Co., Beaumont, Tex.
Woodman, C. M. (Re-election), Southwestern Bell Tel. Co., Dallas, Tex.

8. Pacific

Airgood, W. H., General Elec. Co., Oakland, Calif.
Best, N. L., Johns Manville Sales Corp., San Francisco, Calif.
Bowen, D. L., North American Aviation, Inglewood, Calif.
Brown, R. N., Lt., USNR, San Francisco Naval Shipyard, San Francisco, Calif.
Christie, A. B., Southern Calif. Edison Co., Ltd., Los Angeles, Calif.
Farmer, F. H., Tide Water Associated Oil Co., Associated, Calif.
Fink, R. C., Dept. of Water & Power, Los Angeles, Calif.
Fulton, E. C., Imperial Irrigation Dist., Imperial, Calif.
Grimes, G. R., Southern California Edison Co., Los Angeles, Calif.
Kirkpatrick, A. E. (Re-election), 252A Mosley Ave., Alameda, Calif.
McCann, J. J., Pacific Gas & Elec. Co., San Francisco, Calif.
McCormick, J. G., General Elec. Co., San Francisco, Calif.
Meyer, J. H., The Pacific Tel. & Tel. Co., San Francisco, Calif.
Michelini, L. A., San Francisco Naval Shipyard, San Francisco, Calif.
Parr, C. W., Western Elec. Co., Los Angeles, Calif.
Partridge, R. W., Lockheed Aircraft Corp., Burbank, Calif.
Schermerhorn, G. D., Public Works Dept., U. S. Navy, San Diego, Calif.
Schricker, G. R., North American Aviation, Inc., Inglewood, Calif.
Short, H. A., Colorado River Agency, Parker, Ariz.
Thielman, N. W., Lockheed Aircraft, Burbank, Calif.
Turpen, R. D., General Elec. Co., Los Angeles, Calif.
Van Marter, C. E., Union Oil Co., Oleum, Calif.
Weaver, V. L., General Elec. Co., Los Angeles, Calif.
White, C. C., U. S. Naval Air Station, North Island, San Diego, Calif.
Yarnell, N. K., Southern Calif. Edison Co., Los Angeles, Calif.

9. North West

Ango, F. S. (Miss), Bonneville Power Admn., Portland, Oreg.
Belsher, M. W., Bonneville Power Admn., Portland, Oreg.
Berg, N. J., Puget Sound Naval Shipyard, Portland, Oreg.
Boston, J. R., Bonneville Power Admn., Portland, Oreg.
Brewster, R. W., Bonneville Power Admn., Portland, Oreg.
Brintzenhoff, T. O., Portland Housing Authority, Vanport City, Oreg.
Burns, G. L., Bonneville Power Admn., Portland, Oreg.
Collins, H. E., Westinghouse Elec. Corp., Portland, Oreg.
Cramer, W. W., The Pacific Tel. & Tel. Co., Portland, Oreg.
Ekroth, W. W., Bonneville Power Admn., Portland, Oreg.
Fleming, A. E., General Elec. Supply Corp., Salt Lake City, Utah.
Garland, W. R., Boeing Aircraft Co., Seattle, Wash.
Hillend, V. J., Commercial Iron Works, Portland, Oreg.
Hughart, C. R., Bonneville Power Admn., Portland, Oreg.
Johnson, D. A. (Re-election), Bonneville Power Admn., Portland, Oreg.
King, J. K., Administration Building, Vanport City, Portland, Oreg.
Kittner, F. J., Bonneville Power Admn., Portland, Oreg.
McLean, J. J., Bonneville Power Admn., Vancouver, Wash.
Miller, H. N., Westinghouse Elec. Corp., Portland, Oreg.
Moisenco, A. S., Lieut. (jg), U.S.N., A. I. M., Portland, Oreg.
O'Brien, L. E., Bonneville Power Admn., Portland, Oreg.
Pashley, H. B., Bonneville Power Admn., Portland, Oreg.
Scheuerman, L. N., Bonneville Power Admn., Vancouver, Wash.
Schroeder, H. B., Bonneville Power Admn., Portland, Oreg.
Smith, G. A. A., Elec. Smith Co. Contractors, Spokane, Wash.
Thornbrue, D. H., General Elec. Co., Seattle, Wash.
Wall, C. E., U. S. Engineers, Portland, Oreg.
Weber, J. G., 1231 S. E. 58th Ave., Portland, Oreg.
Weiner, L., Bonneville Power Admn., Portland, Oreg.
Willis, R. C., Northwestern Elec. Co., Vancouver, Wash.
Woster, R. E., Northwestern Elec. Co., Vancouver, Wash.

10. Canada

Blakeley, W. R., The Hydro-Elec. Power Comm. of Ontario, Toronto, Ont., Canada
Carter, R. B., Canadian Westinghouse Co., Hamilton, Ont., Canada
Haines, A. L., Canadian Westinghouse Elec. Corp., Hamilton, Ont., Canada
Smith, H. A., Hydro-Elec. Power Comm. of Ontario, Toronto, Ont., Canada

Elsewhere

Bebbington, D. W. G., Dominion Physical Lab., Wellington, N. Z.
Bernal, R., Jr., P. R. Transportation Authority, Hato Rey, P. R.
Bhatt, N. N., Bombay Gaurage (Rajkot), Ltd., Rajkot, Kathiawar, India
Bowman, W. G., Westmorland & Dist. Elect. Supply Co., Ltd., Westmorland, England
Camarena M., P., Donceles 106, Desp. 24, Mexico City, Mex.
Carbajal S., A., Cia Distribuidora Westinghouse, S. A., Mexico City, Mex.
Celada S., J., Nacional de Electricidas S. A., Torreon, Coah., Mex.
Garcia, J. E., Cia. Nacional de Electridad S. A., Torreon, Coah., Mex.
Kenney, B. D., Tropical Oil Company, Bogota, Columbia, S. A.
Kioilos, L. M., American Farm School, Salonika, Greece
Lliteras, J. A., P. O. Box 425, Ponce, P. R.
Machado Z. O., Electricidad de Caracas, Caracas, Venezuela, S. A.
Marshall-Wood, L., Admiralty Signal Est., Manchester, England
Neckelmann E., R. H., Wessel, Duval & Co., S. A. C., Santiago de Chile, S. A.
Patel, J. L., Kesar Sugar Works, Ltd., Baheri U. P., India
Rajgarhia, C., India Mica Supplies Co., Ltd., Ghiridi, India
Riemann D., R., Comision Federal de Elect., Mexico, D. F., Mex.
Robertson, A., Messrs. Bruce Peebles, Co., Ltd., East Pilton, Edinburgh, Scotland
Singh, H., P. W. D., Punjab, Lahore, India
Tikare, T. B., British Insulated Callender's Cables, Ltd., Bombay, India

Total to grade of Associate
United States and Canada, 241
Elsewhere, 20

OF CURRENT INTEREST

Great Barrington Celebrates First A-C Street Lighting

The first community in America to be lighted by a-c electricity, Great Barrington, Mass., observed the 60th anniversary of the event March 23, 1946, when Governor Maurice J. Tobin unveiled a plaque memorializing the achievement of William Stanley and George Westinghouse.

The bronze plaque, which will be mounted on a granite stone on the lawn in front of the Town Hall, is inscribed:

Commemorating the life and work of George Westinghouse and William Stanley, ingenious inventors and pioneer organizers of the electrical industry.

Who made possible America's first town lighting system by the use of alternating electric current at Great Barrington, Massachusetts, March 20, 1886.

Erected on the sixtieth anniversary of the occasion and in the one hundredth anniversary year of the birth of George Westinghouse, by the Westinghouse Electric Corporation. Unveiled by Governor Maurice J. Tobin of the Commonwealth of Massachusetts March 23, 1946.

Presentation was made by Frank L. Nason (A '43) manager of the New England district for the Westinghouse Electric Corporation. It was accepted for the town by Francis J. Kelly, president of the Board of Selectmen. Judge Thomas F. Conneally of the Southern Berkshire District Court presided during the ceremonies.

William Stanley, who was thus honored, became associated with the Westinghouse organization in 1884 and installed and equipped an incandescent lamp factory at Swissvale, Pa. When, in 1885, at the age of 27, he moved because of illness from Pittsburgh, Pa., to Great Barrington, he set up the first a-c plant in America, incorporating his ideas on long-distance light and power transmission, and in 1886 this plant distributed to the town 500 volts through transformers connected in multiple. The Westinghouse company then took over the manufacturing details and installed the Stanley apparatus at Niagara Falls, N. Y.

Communications Center at UN Headquarters

A complete domestic and international telegraph, telephone, cable, and radio communications center was established at Hunter College, New York, N. Y., for the use of the United Nations during the current Security Council meetings. High speed radiotelegraph and cable service to all parts of the world thus is available to the press and to diplomatic representatives attending the conference.

Communications facilities for the press were set up in the college gymnasium, while on the main floor of the building a commercial office was equipped to handle diplomatic, commercial, and personal traffic for the delegates. It is estimated that during the time the conference will be in session press and government messages totaling over 1,000,000 words will be dispatched to every civilized country in the world. In addition to other facilities, television was installed to give animated contact with sessions to the bulk of the reporters and other visitors not accommodated among the limited attendants in the session hall.

Engineering Society Presidents Laud Addition to McMahon Bill

Inclusion of a division of engineering in the commission of civilians which will administrate the use of atomic energy under terms of the McMahon Bill (S 1717), recently approved unanimously by the Atomic Energy Committee of the United States Senate, was lauded by AIEE president William E. Wickenden (F '39), together with the presidents of three other national engineering societies, in a telegram to Senator Brien McMahon of Connecticut, chairman of the committee. The message applied to the draft of the bill in committee on April 12, 1946.

The telegram, which was signed by Mr. Wickenden, W. W. Horner, president, American Society of Civil Engineers, D. Robert Yarnall, president, American Society of Mechanical Engineers, and James G. Vail, president, American Institute of Chemical Engineers, reads as follows:

"The undersigned address you as individuals who believe that the greatest possible advantage should accrue to the public welfare from the use of nuclear energy. Our profession has already contributed largely to the development of nuclear energy, several thousand engineers having been associated in engineering responsibilities in the work of the Manhattan District. We know of the destructive use of nuclear energy but our interest is in its greater use for public good.

"We agree in general with the provisions of your Senate Bill 1717 as heretofore published. We believe that the Federal administration of all matters dealing with materials fissionable by chain reaction should be in the hands of agencies that are essentially civilian in makeup. We believe that the Federal government has a responsibility for the safe use of these materials. We believe that the greatest advantage from the use of these materials will be for civilian industrial purposes. In the interest of these greater uses of nuclear energy we believe that the widest opportunity should be given for industrial research under Commission license. All use of nuclear energy for industrial purposes should be under license by the Atomic Commission but with the facilities owned by industry.

"In a forward-looking program of the extent required to develop nuclear energy for industrial purposes, it is important that sound judgment in the use of time, money, and material should be applied to the work of the Atomic Commission. Engineers in performing their daily tasks are concerned with economy in the uses of time, money, and material. As reported in recently published amendments to your Bill the inclusion of a division of engineering in the Commission meets this need. We appreciate its addition and are confident that the division will prove its worth and your wisdom in including it.

"We appreciate the tremendous responsibility you have undertaken in stating a policy for this Nation to follow in dealing with this new source of useful energy."

NAM Opposes Kilgore-Magnuson Bill

Specifically attacking the overgreat power it lodges in the President as a potential source of undue political influence, the broad legislating it does regarding patents, its possible interference with academic freedom, and the modicum of authority with which it invests the advisory board of scientists, the National Association of Manufacturers recently expressed disapproval of the National Science Foundation bill, S 1850, through R. J. Dearborn, chairman of NAM's committee on patents and research.

Research would be hindered seriously through unwarranted Government competition if the bill were enacted, Mr. Dearborn declared. The centralization of enormous power over both science and technology in the executive department of the Government would have a disastrous effect on the free enterprise system, he stated.

NAM favors the creation of a National Science Foundation to procure the full development of this country's scientific and technical resources along the lines recommended by Doctor Vannevar Bush (F '24) director of the Office of Scientific Research and Development, in his report, "Science, the Endless Frontier," according to Mr. Dearborn.

"Instead of providing a relatively simple organization consisting of a group of people well versed in the various scientific fields who would be in a position to advise the President and make recommendations to the Congress of what they needed and how the funds to support basic science might be expended, the Kilgore-Magnuson legislation has the tendency to provide an elaborate Governmental setup," he said. This of itself would give many opportunities for the operation of the spoils system, he added.

Though the bill tries to guard against political influence by setting up an advisory board, NAM points out that there is little guarantee that this Board itself would be politically inviolable, because of powers the bill confers upon the President.

Another objection to the Board voiced by NAM is that it is only advisory and, having no authority, is unlikely to attract the best scientific brains of the country. Were it to have full responsibility for the activities of the Foundation, outstanding scientific leaders would serve on it, NAM believes.

There is also the fear by educational institutions that they will be dominated by the Federal Government, Mr. Dearborn pointed out. They feel that in other spheres of activity the use of Government funds has carried with it certain stipulations as to the methods of operation and, to some extent, even partial control.

NAM believes that legislation regarding patents does not belong in a bill for the crea-

tion of a National Science Foundation. Such legislation, it declares, should be referred to the Congressional Committee on Patents. S 1850, on the other hand, attempts to legislate with respect to all patents resulting from research and development conducted directly by the Government as well as research and development by outside agencies financed in whole or in part by the Government.

"The broadest possible power is placed in the Foundation with respect to patents," said Mr. Dearborn. "It is provided that the Administrator, in carrying out his functions, is authorized 'to acquire by purchase or otherwise, hold and dispose of by sale, lease, loan, or otherwise, real and personal property of all kinds necessary for, or resulting from, scientific research or development.' The United States Supreme Court has uniformly and repeatedly held that patents are property, and, hence, property of all kinds' certainly would include patents. NAM feels that the bill should state that this section does not authorize the Administrator to acquire patent rights by condemnation proceedings."

Telephones in Ecuador. Automatic telephone systems will be installed in Quito and Guayaquil, Ecuador, in accordance with a recent contract with a Swedish company. Each city will have an initial installation of 90,000 lines with a capacity for substantial increases in this number. Approximately two years will be required for the installation of the 6,000 automatic telephones that are planned for each city.

Telephone Privacy Upheld by Bell System and USITA

Briefs upholding the "right of privacy" in telephone service against the use of recording devices in connection with telephones have been filed with the Federal Communications Commission by the Bell System telephone companies and the United States Independent Telephone Association. The briefs also opposed the prescription of a tariff regulation governing use of recording devices in interstate and foreign toll telephone service unless it secured full co-operation of the state commissions.

The Bell System brief declared that the right of privacy in telephone communications would "be infringed by use of telephone recorders without adequate notice to both parties" that the conversation was being recorded. It substantiated this by the opinion of Justice Brandeis in the case of Olmstead versus the United States stating that "the evil incident to invasion of the privacy of the telephone is far greater than that involved in tampering with the mails."

Both briefs concurred in the view that there is no record of a widespread demand for "unrestricted" use of recording devices on telephone conversations and that mechanical devices have not been found suitable to indicate to the users that a recording device is being employed. According to the Bell System brief the "operator announcement" plan is the only "practical" way to meet this requirement. However, the USITA pointed out that this plan would add expense for operation equipment and increase the work load of operators, or require more operators, and concluded that there is at this time "no positive and practical method" to notify subscribers of the presence of recording equipment.

Hydroelectric Developments Reported in Various Countries

With the development of the Paulo Affonso Falls of the Sao Francisco River, Brazil, along the lines of the Tennessee Valley Authority, a potential hydroelectric energy estimated at 608,000 horsepower or 448,000 kw will be made available to northeastern industry of Brazil and water and power will be provided for the irrigation of lands which otherwise would be useless. As a result this region, which now is dependent upon southern Brazilian states for agricultural and manufactured products, will be able to supply many of its own needs as well as those of other parts of the country.

In Eire two dams and two power stations will be constructed on the River Erne between Belleek and Ballyshannon. The power stations will be located near Cliffhouse and Cathaleen's Falls and at first will produce an anticipated annual output of 200,000,000 kilowatt-hours which, with full development, will rise to 250,000,000 kilowatt-hours. It is estimated that three years and 1,000 workers will be required to complete the project.

Portugal currently has a total of 110 hydroelectric power plants, operating on 11 rivers, with a total capacity of 99,009 kw generating 204,971,101 kilowatt-hours of electricity. If present plans for dam and plant construction materialize, current in Portugal will be entirely hydroelectric, and output is expected to increase from the 470,000,000 kilowatt-hours used now to 1,500,000,000 kilowatt-hours in 1952. Consumption of electricity in 1943 totalled 397,452,345 kilowatt-hours of which 253,366,758 kilowatt-hours were consumed by Portuguese industry. Annual household consumption in Portugal is low; about 60 kilowatt-hours per capita as compared with 150 in Spain, 300 to 500 in Switzerland, 1,000 in Norway, and 1,225 in the United States.

Plans for the construction of an underground hydroelectric station on Lake Sevan, Armenia, and of 973 smaller hydroelectric stations throughout Russia recently were reported in the Soviet press.

The Lake Sevan project will entail construction of a $5^1/_2$-kilometer tunnel through which the water from the lake will be directed. The high altitude and shape of the lake bottom at present cause evaporation of up to 97 per cent of its water. In addition to providing irrigation to a large farming area, the development is expected to influence the growth of chemical, rubber, aluminum, and food industries in Armenia.

The proposed increase in the number of hydroelectric stations is a notable one when it is remembered that the total number of such stations was 800 at the beginning of 1945. Also reported under construction were 276 small steam power stations. This activity is said to be particularly widespread in the Urals. Of the 103 units being set up in October 1945 by collective farmers in the Molotov region, 43 were already in service. In the Sverdlovsk region of the Urals 179 small hydroelectric stations were under construction in the fall of 1945, as a step toward the goal of the farmers of the region to bring electricity to 1,000 villages in 1945. Electrification of the remaining rural localities in the region has been planned for 1946.

Specifications for a hydroelectric project at Aswan, Egypt, which will require three years for completion and which will develop 500,000 horsepower have been prepared in London, the Egyptian press reports. A unique feature of the project is that the removal of the surface earth or underlying granite in the vicinity of the dam must be done by mechanical means rather than by dynamiting, to avoid the danger of weakening the twice-heightened dam.

An agreement has been reached for the preparation of plans for hydraulic works in the mountains near Athens, Greece. Preliminary studies and scientific research have been made toward the creation of artificial lakes to furnish 1,830,000,000 cubic meters to the Athens water supply. This is expected to provide electric energy from water power amounting to about 687,000,000 kilowatt-hours a year.

Bibliography of Scientific and Industrial Reports Issued

A "Bibliography of Scientific and Industrial Reports Distributed by the Office of the Publication Board" now is being sold in weekly installments by the Superintendent of Documents, Government Printing Office, Washington, D. C.

Each issue contains a systematic catalogue of the thousands of scientific and industrial reports that are being made available to the public through the Office of the Publication Board, Department of Commerce. The bibliographies list the serial numbers, prices, and titles of newly available reports, grouped according to subject matter. A brief summary of the contents of each report is included. The reports described provide information on scientific and technical developments, processes, products, inventions, and related matters previously subject to security restrictions. The industrial reports being made by Army, Navy, and industrial experts on German and Japanese industry are included.

Prices of the weekly bibliographies vary in accordance with their size. A definite yearly subscription rate therefore cannot yet be determined. However, the Superintendent of Documents will accept an initial payment of $10 for the service and will notify subscribers when additional re-

mittance is required. Copies also may be purchased singly. The price per copy of those already issued has ranged from 15 cents up. Each issue since January 25 has covered 300 or more reports.

Railway Electrification Planned in Europe and South Africa

Announcement of the conversion of all or part of their railroad systems to electric operation recently has been made in Belgium, Holland, Norway, France, and South Africa, according to the press in those countries.

All Norwegian main railway lines will be electrified within 15 years, Kristian Loeken, the Director General of Norway's state operated railways, has announced. The Sorland line and Kongsvinger line will be completed first and the Oslo–Bergen line last. Parliamentary approval already has been given to the electrification program.

The decision to convert the whole steam-operated railway system of Holland to electric traction was made by the Netherlands Government in June 1945. Of the 373 miles electrified before the war, the overhead wires on only 75 route miles remain intact. Overhead wires have been removed from 205 miles of road and 93 miles have been stripped completely. From 46 of the 75 substations all transformers, mercury-arc rectifiers, and switchgear have been removed.

Large-scale electrification in the near future is planned by the Belgian Government, although the country now has only 27 miles of electric traction on the line between Brussels and Antwerp.

Conversion to electric traction of 206 miles of track is contemplated for the South African Railways. When the works in progress or authorized are completed, the electrified mileage in the Union of South Africa will be 847 miles.

In France electrification of the remainder of the Paris–Lyons route of the French Government Railways has been projected. The route is now 25 per cent converted from steam.

Tower for Microwave Experiments

Construction of a 300-foot tower to be used as an experimental laboratory and center for microwave radio functions was begun recently at Nutley, N. J., by the Federal Telephone and Radio Corporation of Newark, N. J. The "microwave tower" will be used for experiments such as frequency modulated broadcasting, televison, pulse time modulated broadcasting, aerial navigation, and radar applications which previously had to be made in tall office buildings or other tall structures not well adapted to the purpose. Special antenna mounts have been devised to simplify the installation and removal of antennas for experimental work and the upper decks and roof of the tower will be heated to preclude the formation of snow and ice. In addition to the tower, a two story laboratory also is being erected. This building will be of dry-wall construction, aluminum on the outside with glass wool insulation and partitions of asbestos compound on the interior

Oak Ridge Realized Exceptional Safety Record

Management of the town of Oak Ridge, Tenn., which grew during the completion of the atomic bomb project from an initial population of 500 to one of 75,000, was accomplished by the Turner Construction Company with resulting accident frequency and severity rates lower than the national average. The company, which worked through its wholly owned subsidiary, the Roane-Anderson Company, was responsible for safety measures in both the residential and production areas of the community, as well as for providing every community need of an American city of like size.

Though excess speed normally is the enemy of safety, at Oak Ridge both speed and safety had priorities, with secrecy an ever-present condition for all operations. None of the 12,000 employees of the company knew what was being made in the production areas. Even Raymond T. Bartnett, chief safety engineer, was ignorant of what was being manufactured.

Utilities, building maintenance, and railroads were assigned to one safety engineer; dormitories, housing and cafeterias to another; medical, cleaning, construction, fuel distribution and refuse to another; salvage yards, administrative, fire department, roads and streets and farm departments to another; supplies, warehouses, coal storage, central warehousing, equipment repair and motor pool departments to another. A fleet engineer was responsible for a vehicle safety program.

Expenditures of the safety department, however, were less than one half of one per cent of the total company payroll. The entire departmental program was carried on with a total of eight safety engineers, one fleet engineer with a driver training assistant, one statistical engineer, one statistical assistant, and five clerical assistants. With its major responsibility an industrial safety program, the department dealt with every conceivable type of working exposure.

"While we had our share of the more interesting and dramatic problems, such as fumigation with hydrocyanic acid gas and methyl bromide, railway freight operations of labeled cargoes, high voltage operations and maintenance, operation of an abbatoir and others, we still had the usual floor falls and material handling troubles," according to Mr. Bartnett.

In spite of all abnormal circumstances, the above-average safety record was established. The national frequency average computed and weighed for similar operations was 20.27. The Roane-Anderson 1944 cumulative frequency was less than

50 per cent of this, and for the first eight months of 1945 was less than 30 per cent of the national average. Severity rates were under 40 per cent of the national average.

Microwave Bands Standardized By National Bureau

The entire microwave range up to 33,000 megacycles per second has been arranged, in the radio frequency standards recently established by the National Bureau of Standards of the Department of Commerce, to give some degree of order to the rapid wartime developments expected to revolutionize radiobroadcasting. The term microwave has been applied to frequencies above 1,000 megacycles per second, and the new range is about 30,000 times higher than the present broadcast band.

For purposes of classification and allocation, microwaves are divided into four bands, with the following nomenclatures:

Designation	Symbol	Megacycles	Wavelength in Centimeters
High	HF	3–30	10,000–1,000
Very high	VHF	30–300	1,000–100
Ultrahigh	UHF	300–3,000	100–10
Superhigh	SHF	3,000–30,000	10–1

The new standards have an accuracy of one part in 10 million. In the ultrahigh and superhigh frequency bands, this accuracy is better than one part in 100 million. These fixed frequencies cover the two bands at intervals of approximately one per cent, which is the normal separation between stations operating in the conventional broadcast band.

The number of new channels and the high degree of precision in the separation makes available the largest possible number of usable channels and reduces interference to a minimum. Generally speaking, microwaves extend from 10 centimeters down, and the Bureau of Standards experts now are working on the millimeter region.

FCC Institute Survey of Overseas Communications

With a view toward the formulation of a policy for the future development of radiotelegraph service from the United States to foreign points, the Federal Communications Commission has planned a general review of the present status of overseas communications. All international radiotelegraph carriers were invited by the FCC to file renewal applications of licenses expiring December 1, 1946, for point-to-point stations in the fixed public service. The applications set forth all points the carriers propose to serve during the new license period including those for which they are authorized on a special temporary basis.

Recent disclosures by the War Department reveal that its radioteletype channel between Washington, D. C., and Moscow will be taken over by RCA Communications and Mackay Radio some time in May. A similar arrangement has been made with regard to the British channels which were joint government operated before the war. In response to reports that the Washington–Moscow channel had its terminus in the Pentagon building, the War Department pointed out that the circuit actually is connected to the Soviet Embassy and that only switching and relaying equipment is located in the Pentagon.

Supersonics Find Military and Industrial Applications

The term supersonic has been applied to any kind of vibration above 20,000 cycles per second—the highest frequency the human ear can detect. An invaluable agent during the war the peacetime applications of supersonics are increasing daily.

Flaws inside metals of any thickness can be detected through its use. The sound waves can be sent through metal in a manner which permits plotting of the approximate size, shape, and location of flaws. Others of the varied applications include acceleration of chemical reactions, alloying metals, in television reception, for photographic emulsions, and for clearing smoke out of the air through the process of precipitation.

Supersonics, which travel 4,200 feet per second through water, helped during the war to combat Axis submarines by making it possible to detect the range of the underwater craft.

Mexican Communications. Mexico's telecommunications system will be modernized to connect Mexico with the entire world according to a recent announcement of the Mexican Ministry of Communications and Public Works. Modernization of the radiotelephonic and radiotelegraphic services, authorized by President Camacho, will be carried on this year, and for this purpose equipment valued at five million Mexican pesos (about $1,000,000) has been acquired from American manufacturers.

Army Purchase Information. A Purchase Information Section has been established under the Procurement Division, United States Army Service Forces, Room 3 C 467, The Pentagon, Washington, D. C., to display to prospective bidders and interested persons invitation for an abstracts of bids issued by Army contracting officers for Army equipment, supplies, and construction. Under a recently established policy of the War Department procurement shall be by formal advertising and competitive bidding whenever practicable and, though authority to negotiate contracts still exists, it is to be exercised only in cases where advertising procedures are likely to produce less favorable results.

Argentine Engineers Honor American. Dean S. S. Steinberg of the University of Maryland college of engineering has been notified of his election as an honorary member of the Argentine Society of Engineers, Buenos Aires, Argentina, "in recognition of his professional attainments and his outstanding work in promoting closer relations among the members of the engineering profession in the three Americas." During his good-will tour of Latin America last summer, under the auspices of the United States Department of State and as the representative of engineering societies in the United States, he was similarly honored in Ecuador, Uruguay, and Mexico.

Registration of Engineers. An injunction has been granted the Ohio Society of Professional Engineers by the Common Pleas Court to enjoin Designers for Industry, Inc., Cleveland, perpetually from causing or authorizing any officer, director, agent, or employee who is not a registered professional engineer under the laws of Ohio to practice or offer to practice engineering in Ohio. This is the first suit filed by the society and amounts to holding valid the engineers registration act of Ohio, sustaining a society contention that injunction suits may be brought against nonregistered persons who attempt to practice engineering.

RESEARCH . . . .

Grants for Research Made; Engineering Work in Minority

An initial list of Frederick Gardner Cottrell special grants in aid of postwar research totaling nearly $175,000 has been announced by Joseph W. Barker (F '30) president of the Research Corporation, New York, N. Y.

Additional grants will be forthcoming upon recommendation of the corporation's advisory committee which at present has other applications under investigation. The corporation is interested in receiving high quality applications for grants from engineering and smaller liberal arts colleges. In the list just issued, engineering research problems are most notable for their scarcity. Research Corporation explains this by saying that engineering schools simply have not submitted supportable projects so far, though hope is expressed that they soon will.

According to Doctor Barker, initial grants are not made for more than one year at any one time, except in rare cases, although support will be continued for four or five years if progress of the project warrants it.

A special fund of $2,500,000 was established in 1945 to inaugurate the Cottrell grants-in-aid, because it is believed that the immediate postwar period is a crucial one for research and teaching in American edu-

cational institutions, Doctor Barker explained.

With the pattern of research in colleges and universities disrupted by the war educators face the problem of whether talented men drafted into war research "can be brought back to the college laboratories and classrooms where there is great necessity for them, if we are to re-establish adequate research closely associated with inspired teaching," Doctor Barker said. He pointed out that the strain imposed upon teaching staffs by the flood of returned veterans may hinder the re-establishment of adequate fundamental research.

"It was felt that such a program of aid to fundamental research in the pure and applied sciences would be of great value at this time when wartime research men are considering whether to return to educational institutions or to accept industrial positions.

Following is a list of the institutions, the projects, and their directors to which the initial Frederick Gardner Cottrell special grants-in-aid for postwar research have been made:

Amherst College, for design and construction of equipment for measuring faint stars by the photoelectric method; Doctor John S. Hall.

Boston University, for an experimental examination of the properties of the solvated electron by calorimetric, density, and viscosity studies of the alkali metal liquid ammonia systems; Professor Lowell V. Coulter.

University of California, for the correlation of photochemical processes with molecular absorption spectra; Doctor F. E. Blacet.

Carnegie Institute of Technology, for work on the properties of matter at extremely low temperatures. Superconductivity, especially of thin films; Professor Immanuel Estermann.

Catholic University, for a study of chemical reactions between gases and solids; Doctor Walter John Moore, Jr.

Duke University, for a study of microwave absorption spectra of molecules; Doctor Walter Gordy.

Indiana University, for a study of beta disintegration process; Doctor L. M. Langer.

Kansas State College, for a study of photoelectric and thermionic properties of spectroscopically and thoroughly outgassed nickel with emphasis on studies at the Curie point; Doctor A. B. Cardwell.

Michigan State College, for a study of ionization produced in gases by electrons of energies less than 2,000 electron volts; Doctor Thomas H. Osgood.

University of Minnesota, for an analysis of electron and ion collision phenomena in gases and vapor; Doctor John T. Tate.

University of Minnesota, for research on isotopes; Doctor A. O. C. Nier.

Muhlenberg College, for the measurement of the velocities and absorption coefficients of sound waves in gases as a function of temperature and pressure at various supersonic frequencies; Doctor I. F. Zartman.

University of New Hampshire, for a study of inorganic fluorides; Doctor H. M. Haendler.

North Texas State Teachers College, for stereoisomerism of synthetic and natural polyenes; Doctor R. B. Escue, Jr.

New York University, Investigation of nuclear disintegrations produced by cosmic radiation; Doctor Serge A. Korff.

University of Notre Dame, for the extension of experiments on the excitation of nucleuses by X rays and electrons by observation of shorter metastable lifetimes and for the extension of experiments on the excitation of nucleuses by X rays and electrons by increasing excitation energy; Doctor George B. Collins, Doctor Bernard Waldman.

Ohio State University, for work on infrared spectra of a large number of polyatomic molecules measured automatically under high dispersion; Doctor H. H. Nielsen.

Oregon State College, for synthesis of amino alcohols derived from pyrimidines and quinazolines; Professor B. E. Christensen.

Pennsylvania State College, for study of influence of range of stress on the fatigue strength of metals subjected to axial and biaxial stresses; Doctor John A. Sauer.

University of Pennsylvania, for work in nuclear physics; Doctor G. P. Harnwell.

Queens College, for isotope research; Doctor M. L. Eidinoff.

Rutgers University, for work on nuclear and electronic paramagnetism at room and low temperatures; Doctor F. G. Dunnington.

Stanford University, for research on nuclear induction and its application to polarized neutrons; Doctor Felix Bloch.

Stevens Institute of Technology, for a study of absorption spectra, particularly in the far ultraviolet, of liquids to be followed later by studies of other properties, etc. Doctor E. G. Schnieder.

Tuskegee Institute, for research on the methods of preparation and the chemical properties of the bisbrominated ethers; Doctor C. T. Mason.

Southwestern at Memphis, for a study of vapor phase catalytic preparation of high molecular weight ketones; Doctor J. L. A. Webb.

University of Tulsa, for a study of distribution of carbon dioxide in systems containing two liquid phases; Doctor F. T. Gardner.

State College of Washington, for study of (a) Enthalpy changes at unit surfaces on wetting of solids by liquids; (b) a study of significance of variations in the values of the densities of fine powders as measured in various liquid media; (c) development of new techniques for the study of liquid films at solid-liquid interfaces; Professor J. L. Culbertson.

University of Wyoming, for research on determination of neutron resonance energies and half life periods of induced radio activities; Doctor Emil J. Hellund.

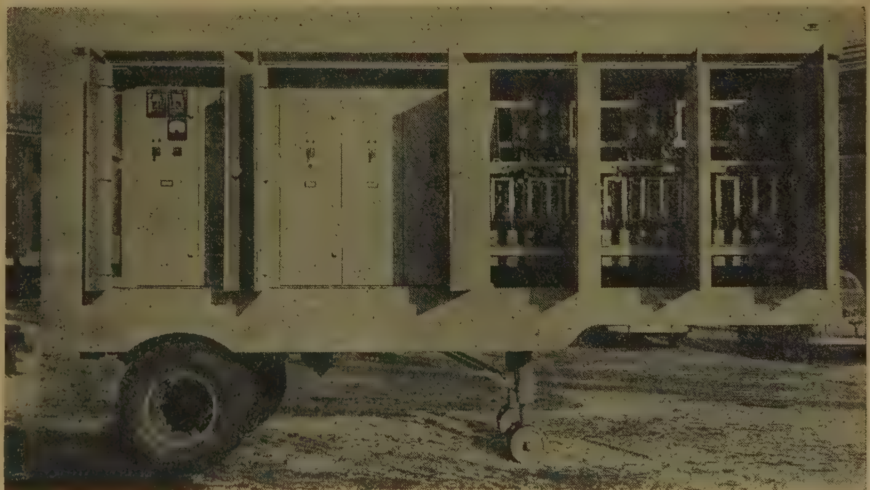
Research Corporation is a nonprofit organization devoted to advancing research and technology by use of revenues from patents assigned to it by interested inventers. The corporation was established in 1912 with the gift, through Doctor Frederick Gardner Cottrell, of patent rights on electrical precipitation. The corporation since has served colleges and universities by the administration of patents arising from researches in their laboratories. From the proceeds it has aided some 52 institutions by grants totaling more than $1,250,000.

The following is the advisory committee which examines the worth of applications for the grants:

Doctor W. D. Coolidge (M '34) of the General Electric Company laboratories, Doctor Thomas N. Chilton of the Du Pont company, Doctor Lloyd P. Smith of Cornell University, Mr. Timothy E. Shea of Western Electric Company, Colonel Staffer Warren of the Medical School of the University of Rochester, and Doctors R. R. William and J. W. Barker of Research Corporation.

Purdue Studies Electrified Farm. The study of "the proper and more efficient use of electric power in rural areas" has been undertaken at Purdue University, Lafayette Ind. Plans for the project call for the purchase of a general purpose farm where studies can be made of at least 200 applications of electricity to farm chores.

Mobile Capacitor Unit for Power Lines



This 4150-volt capacitor unit designed by the General Electric Company will help carry emergency and seasonal overloads for the Consolidated Gas, Electric Light, and Power Company of Baltimore, Md. It consists of six 180-kilovar banks of Pyranol capacitors mounted on a Fruehof model 5 semitrailer chassis. Three of the banks are arranged for automatic control and three for manual. The capacitor equipment is connected to the lines by means of cables carried on reels in a rear compartment. A Magne-blast circuit breaker protects the unit

Navy Reveals Secret Gas Turbine to Editors

At the Naval Engineering Experiment Station, Annapolis, Md., the Navy lifted its wartime veil of secrecy March 29, 1946, and demonstrated its experimental gas turbine to a group of technical editors of national publications. Built by the Allis-Chalmers Manufacturing Company, this experimental gas turbine has been under test at Annapolis for the past two years.

The turbine has been operating at 1,350 degrees Fahrenheit, the highest temperature yet sustained for long periods of time for such a machine, and it is hoped gradually to raise the operating temperature to 1,500 degrees Fahrenheit. The instrumentation of the test setup is so complete that 2,000 different readings of temperature and pressure throughout the gas turbine during a 7-hour test period was reported to the visitors as being normal procedure.

The gas turbine operates much the same as a steam turbine, except that it uses hot air instead of steam to spin the turbine blades, and thus eliminates the necessity of boilers, condensers, and complicated steam lines, all of which occupy valuable space in naval vessels. The Navy also is interested in the fact that the gas turbine cycle can be operated at much higher temperatures than the practical limitation of 850 degrees Fahrenheit for shipboard installations now prevailing in steam turbine construction. This can be translated into less weight, less space, higher thermal efficiency than the steam turbine, thus increasing the cruising range of Navy ships.

"Although this gas turbine plant has been developed as a Navy project, it has characteristics applicable for both land and marine use," according to Doctor J. T. Rettaliata, consulting engineer for gas turbines at the Allis-Chalmers Company and director of the mechanical engineering department at the Illinois Institute of Technology. "Engineers" he continued, "regard it as a highly significant step in development of what has been called the fourth prime mover—following the steam engine, the steam turbine, and the internal combustion engine. Optimistic engineers in recent years have forecast eventual use of gas turbine power plants to generate electric power for industrial plants and to serve as propulsion power for planes, ships, and locomotives."

Gas turbine research and testing will continue at the Naval Engineering Experiment Station at Annapolis. When the new Engineering Experiment Station building is completed in July, all Navy gas turbine research will be centered at Annapolis.

Signal Corps Research at Princeton. A two-year contract entailing the expenditure of $100,000 for fundamental research in high polymer chemistry and engineering in plastics has been awarded Princeton University by the United States Army Signal Corps. The work will be entrusted principally to advanced students under the direction of a plastics committee representing the departments of chemistry, physics, chemical, electrical, and mechanical engineering. The school of engineering at Princeton University offers a recently approved graduate curriculum in plastics leading to an advanced engineering degree. Candidates for the degree must complete a minimum of two terms of five courses each, among which the following are prescribed: properties of plastics, plastic product and equipment design, electrical measurements, chemical engineering of high polymers, and high polymer chemistry. Work on the Signal Corps research project will supplement this program, and those so engaged will work as research fellows.

ASHVE Purchases Research Laboratory. To provide adequate research facilities for serving the entire heating, ventilating, and air conditioning industry as well as associated industries, the American Society of Heating and Ventilating Engineers has opened a new research laboratory in Cleveland, Ohio. The site of the new laboratory contains a substantial dwelling with a large two-story brick auditorium type building attached. The brick building, which is 58 by 125 feet on its foundations houses the laboratory building. The Society's research program is in its 27th year.

INDUSTRY . . . . .

High Frequency Radio Tested for Railroad Use

A three-day test of high frequency railroad radio communications to demonstrate the most effective methods by which railroad mobile radio techniques could enable yardmasters to keep in constant touch with all locomotives under their direction was held recently by the Detroit, Toledo, and Ironton Railroad in conjunction with the Farnsworth Television and Radio Corporation. The Detroit–Dearborn, Mich., area was chosen as the site for the test because engineers believed that equipment meeting requirements in this congested traffic center would be effective anywhere in the world.

For the tests, high frequency transmitter–receiver equipment was installed in the railroad yardmaster's office and in the cabs of a steam and of a Diesel-electric locomotive. Also an unattended satellite booster transmitter–receiver was erected in the Ford Motor Company plant, Dearborn, to extend the range of the yardmaster's primary transmitter and to eliminate "dead spots" caused by the terrain or structural obstructions in the path of the high frequency wave radiation. At one point in the demonstration a steam locomotive and coach passed through a ten-mile series of steel-reinforced concrete arches standing at three-foot intervals. These obstructions would interfere seriously with standard broadcast signals but would not affect the very high frequency tests.

FPC Authority Sought for Pipe Line to Transport Gas

Application for authority to construct the necessary conversion facilities and to operate the Big Inch Pipe Line to transport natural gas to New York, New Jersey, and eastern Pennsylvania has been made by Big Inch Gas, Inc., to the Federal Power Commission. An offer to the War Assets Corporation of $40,000,000 for the Big Inch is made in conjunction with an offer of Big Inch Oil, Inc., to purchase the Little Big Inch for transportation of petroleum products.

Conversion, which is expected to begin immediately upon acquisition of the pipe line, will consist of cleaning and testing the line, installing 13 or more compressor stations with over 100,000 aggregate horsepower, and constructing delivery lines to consumers. Upon completion of construction, the line would be put into operation with a capacity of approximately 275,000,000 cubic feet of gas daily.

According to a report of the Surplus Property Administration, the Big Inch pipe line is a welded steel 1,340-mile line, 24 inches in diameter (except in a few instances), which runs from Longview, Tex., to Linden, N. J. Built during the war, it replaced tanker delivery of crude oil to the East to eliminate loss through attack by enemy submarines. The Little Big Inch, which is to be operated as a petroleum products transportation pipe line, is a 20-inch line extending from Texas City, Tex., to Linden. It also was constructed during wartime to replace tanker delivery of petroleum products.

Somervell Receives Post. General Brehon B. Somervell, retired commander of the United States Army Service Forces during World War II, has been elected president of Koppers Company, Inc., Pittsburgh, Pa. The company builds and operates coke and other coal by-products plants in 24 states where such products as road tars, wood preservatives, and waterproofing materials are made. J. P. Williams, Jr., who has been acting as president and chairman of the board since the death of J. J. Tierney in 1944, will continue as chairman.

Nuclear Physics Course for Employees. A special graduate course on the introduction to "atomistics" and applied nuclear physics has been established for the personnel of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., in co-operation with the Illinois Institute of Technology. The 16-week course, which meets for a two-hour session one night each week, presents a series of guest lecturers including Doctor Don Kerst, who was instrumental in the practical development of the betatron; Doctor G. M. Almy, professor of physics at the University of Illinois; and physicists from the Universities of Chicago and Wisconsin.

Metal Lens Developed for Microwave Transmission

A metal lens capable of focusing radio waves as an optical lens focuses light has been developed at the Bell Telephone Laboratories, New York, N. Y. The new lens is expected to find its most widespread application in microwave radio relay systems such as the New York to Boston channel now under construction. These systems similar to systems developed for the Armed Forces during the war, are designed primarily as adjuncts to the telephone network but may find additional use in transmitting pictures, radiobroadcasts, and television programs, as well as in the peacetime development of radar.

A major problem in the development of microwave communication has been that of transmitting and receiving the wave energy in the form of a narrow beam like that of a searchlight. These very short waves do not follow the curvature of the earth but shoot off into space and so transmission over long distances requires the use of relays. The new metal lens produces the sharp beam necessary to obtain short range transmission between successive relay stations with the least interference.

The lens operates on a principle comparable to that of a simple convex magnifying glass which can focus the sun's rays to burn a hole in a sheet of paper. The utilization of this principle is possible because radio waves are of the same electromagnetic nature as light waves. To overcome the necessity for the huge lens called for by the greater length of radio waves, a system of metal plates is employed which duplicates the action not only of convex and concave lens but also of other optical devices such as half and quarter wave plates and prisms.

Design and development of the metal lens was under the direction of Doctor Winston E. Kock who in 1938, was chosen by Eta Kappa Nu as the outstanding young engineer of the year. Doctor Kock was the third man to be so honored.

Westinghouse International Forms Education Department

Formation of an education department which will act as liaison agency for the technical training of foreign students at the Westinghouse corporation and which will conduct courses abroad for the benefit of foreign associates of the company has been announced by the Westinghouse Electric International Company, Pittsburgh, Pa.

The immediate task of the new department will be the supervision of the training of 500 students from China and Mexico. Of these 300 will be selected by the National Resources Commission of China over a five year period and 200 are to be picked by the Industria Electrica de Mexico, S. A. The students will attend the student engineering course offered by the Westinghouse Electric Corporation, East Pittsburgh, Pa.

An experimental program of setting up courses abroad where representatives of the company's foreign distributors and allied companies can study conveniently also has been inaugurated. A ten-week course in air conditioning and commercial refrigeration will be given in Havana, Cuba, for South American and Caribbean representatives.

In addition to these activities the department will aid in picking future engineers for the International company from American students completing the student course and will form a central bureau for distribution of special electronic and electrical equipment for science laboratories of foreign educational institutions.

Digest of Motion Study Films Made by Management Society

A summary of the motion study records filmed by Frank B. Gilbreth, father of motion study, between 1905 and 1924 has been made available, after five years of preparation, to universities and business and industrial organizations by the Chicago chapter of the Society for the Advancement of Management.

Among the more significant studies included in the digest film are: the brick laying project which led to motion study, factory operations which led to the development of motion study principles, the first studies of surgical operations, Frederick Taylor's pig iron carrying experiment, and a study of skill by the cyclegraph technique. The 1,200 foot 16-millimeter film, which is titled "Original Films of Frank B. Gilbreth," may be obtained from the Chicago chapter of the Society for $75. As the chapter is not staffed to maintain loan service, anyone wishing a preview of the film must make arrangements through the Bureau of Visual Instruction, University of Iowa, Iowa City. The university's film library rate is $4.

RMA and Educators Set School Radio Standards

A program for standardizing radio and sound amplifying equipment in United States schools has been approved by a joint committee of radio manufacturers and educators, the Radio Manufacturers Association has announced.

Plans are now in the hands of the RMA engineering and sound system sections for final drafting of a set of minimum standards for school radio and sound facilities to protect the institutions from inadequate equipment and to permit free exchange of radio educational material.

Tentative specifications were drawn and approved at a recent meeting in Cleveland of the RMA school equipment committee and representatives of the National Education Association, the Association for Education by Radio, and the United States Office of Education. The specifications cover five classifications of school radio and sound amplifying equipment—central program distribution systems, classroom receiving sets, portable transcription players, speech input units, and recorders.

George W. Bacon Retires. George Wood Bacon, one of the founders and lately chairman of the board of the engineering firm of Ford, Bacon and Davis, Inc., retired from active participation in the organization on March 12. Mr. Bacon, who is 77, founded the firm shortly after his graduation from Cornell University in 1892.

Radiotelephone Permits. During the month of March, 221 railroad applications were received by the Federal Communications Commission from railroads planning to install radiotelephone systems of the portable-mobile type. Several railroads have received permits in the meantime under the new FCC rules and regulations for permanent installations of this type of equipment.

OTHER SOCIETIES •

IES Issues New Edition of Street Lighting Code

Recommendations of adequate illumination needed for streets and highways as a means of reducing the high traffic accident and crime rate are made in the new edition of the street lighting code, "Recommended Practice of Street and Highway Lighting," just published by the Illuminating Engineering Society.

Future Meetings of Other Societies

American Chemical Society. National Chemical Exposition, September 10–14, 1946, Chicago, Ill.

American Society for Testing Materials. Annual meeting, June 24–28, 1946, Buffalo, N. Y.

American Society of Mechanical Engineers. Annual meeting, June 17–20, 1946, Detroit, Mich.

American Welding Society. Annual meeting, November 17–22, 1946, Atlantic City, N. J.

Canadian Electrical Association. Annual meeting, June 26–28, 1946, Banff, Alberta, Canada.

Edison Electric Institute. June 3–5, 1946, New York, N. Y.

Great Lakes Power Club. Spring meeting, May 24, 1946, Chicago, Ill.

Illuminating Engineering Society. National convention, September 18–21, 1946, Quebec, Quebec, Canada.

Instrument Society of America. Exhibit and conference, September 16–20, 1946, Pittsburgh, Pa.

International Conference on Large High-Voltage Networks. June 27–July 6, 1946, Paris, France.

National Electrical Manufacturers Association. June 17–19, 1946, Hot Springs, Va.

National Electrical Contractors Association. Annual meeting, October 14–18, 1946, Atlantic City, N. J.

National Electronics Conference. October 3–5, 1946, Chicago, Ill.

National Fire Protection Association. June 3–6, 1946, Boston, Mass.

Pennsylvania Electric Association. Spring meeting, May 28–29, 1946, Harrisburg, Pa.

The result of four years research, the code is used by municipal and utility officials in evaluating the efficiency of street lighting systems and in planning new installations. In stressing the importance of the code, the society notes that two thirds of all traffic fatalities occur during hours of darkness when there is only one third of the volume of daytime traffic.

Because the amount of illumination needed for streets and highways is governed by traffic conditions, the code classifies all roadways according to volume of vehicular and pedestrian traffic. A heavy traffic thoroughfare with a vehicular count of 1,200 to 2,400 vehicles, during a maximum night hour with heavy pedestrian traffic, will need a minimum of 1.2 foot-candles of light intensity for traffic safety, whereas a very light traffic thoroughfare, which generally includes residential streets, will need only 0.2 foot-candles.

The lamp size and luminaire needed to furnish the recommended intensity of light is given, with the mounting height and spacing based on the width of thoroughfare and reflectivity of the pavement surface. Situations such as curves, intersections, railway crossings, bridges, and dual highways also are given consideration.

The first edition of the code published in 1940 was used in planning installations of safety lighting in Detroit, Hartford, Salt Lake City, and Los Angeles.

JOINT ACTIVITIES

Navy Cites ASA for Safety Work

The American Standards Association has been presented with the United States Navy's Certificate of Achievement "in recognition of specialized accomplishment on behalf of the United States Navy and of meritorious contribution to the national war effort." The ASA is the fourth organization in the United States to be given this award.

The citation reads as follows:

'This organization, upon whose Executive Board the Navy has representation, performed a commendable service to the Navy through the preparation and development of Safety standards, codes, and specifications, many of which have been adopted by the Navy. This program of the American Standards Association speeded up the process of the development and preparation of such codes which otherwise would have involved considerable research and, most important, would have taken considerable time to prepare and develop, had the Navy undertaken such tasks without the aid, guidance, and assistance which the American Standards Association so ably rendered."

EDUCATION . . .

Summer Management Course at Iowa. The eighth annual summer management course will be held at the University of Iowa, Iowa City, from June 10 to June 28. The course is designed especially for managers, foremen, industrial engineers, methods, cost accountants, and other executives. The study plan combines fundamental training with practical applications and attention will be given to procedures of conducting factory training programs in the fields covered. Advance registration is required and enrollment is limited. Registrants are expected to be college or university graduates or their equivalents. Tuition and fees for the course are $150 plus living expenses.

First Award Established for Engineering Education

Establishment of a new annual award of $1,000 honoring the college or university teacher adjudged to have contributed most to the successful teaching of engineering students was announced recently by the Society for the Promotion of Engineering Education. To be known as the George Westinghouse Award in Engineering Education, it was endowed by the Westinghouse Educational Foundation in commemoration of the 100th anniversary of the birth of the inventer.

Presentation of the first award will be made in June 1946, and nomination forms have been sent to the deans of the 165 engineering schools of the United States and to the officers and executives of the committees of the society and related national engineering societies. "The task of the committee on the award will involve pioneering in methods of appraising outstanding teaching. The committee already has planned its procedures with great care, and the hope is high for a valid appraisal of distinguished contributions and for success in the encouragement of teaching achievement," the announcement stated.

Doctor Homer L. Dodge, president of Norwich University, Northfield, Vt., is chairman of the committee on award. Other members are:

Doctor Harry S. Rogers, president of the Polytechnic Institute of Brooklyn; Doctor H. P. Hammond, dean of the School of Engineering at Pennsylvania State College; Doctor W. R. Woolrich, dean of the School of Engineering at the University of Texas, Austin; Professor R. T. Birge, University of California, Berkeley; Professor W. Otto Birk, University of Colorado, Boulder; Professor J. W. Cell, North Carolina State College, Raleigh; Professor H. P. Croft, State University of Iowa, Iowa City; Professor H. E. Dycho (F '42) the University of Pittsburgh; and C. A. Powel (F '41) representing the Westinghouse Educational Foundation.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

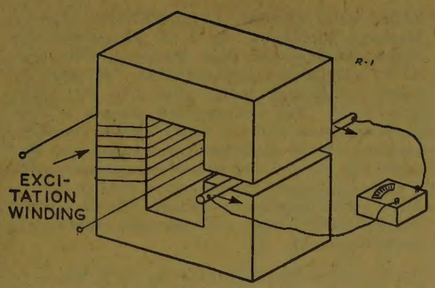
Electrical Essays for Recreation

To the Editor:

My good friend, K. L. Hansen, in his letter (*EE, Feb '46, p 95*) shows that in the example described there, the concept of generating a voltage by the cutting of magnetic lines furnishes the correct answer (no cutting takes place) while the concept of having the voltage generated by a change of flux associated with a loop would lead us to the prediction that there will be a voltage generated during the time that the clip-like loop is slipped over the legs of the magnet (see figure on page 95).

The proponents of the "cutting concept," to date, have not been able to give an explanation satisfactory to this writer of how a transformer operates. To be sure, I have listened to the argument that, since the flux in the core is zero at a given instant, but has reached a maximum one quarter cycle later, the magnetic lines can have gotten into the core only by jumping from space (where they presumably were waiting for the call) into the core, and in so doing must have "cut" through the turns placed around the core, but this seems to me a rather far-fetched explanation. No such mental gymnastics are required when we stick to Maxwell's equation $e = nx(d\phi) \div (dt)$. In a betatron, for instance, electrons are accelerated in an orbit which does not even consist of a conductor, simply by the rate of change of flux associated with this orbit. In this case: who cuts what with what, where, and how?

But while the "cutting" concept in this writer's opinion at least, falls down in explaining the operation of as common a piece of electric equipment as a transformer, the "change of flux linkage" concept is easily applicable even in those cases where the "cutting" concept seems to be a "natural." Consider in Figure 1 the single conductor moved through a constant magnetic field in the direction shown. As one of my teachers used to say: "Nobody has ever measured a voltage without completing a loop," and, if this is applied to the case shown, it is obvious that the flux associated with the loop formed by the conductor, the measuring leads, and the instrument changes by exactly the same number of



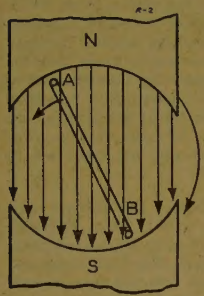
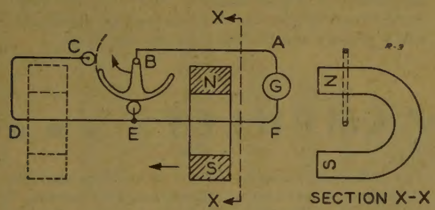


Figure 1 (above)

Figure 2 (left)

Figure 3 (below)



lines as are "cut" by the motion of the conductor. Both concepts, therefore, give the same result. But now assume that the magnetic field in the air-gap is *not* constant, in other words, that the exciting current changes with time. Though it is possible to resolve the voltage induced in this case in two components, a voltage of "transformation" and of "motion," it seems so much simpler to determine the rate of change of the total flux, which then will give us the total induced voltage.

In Figure 2 the cross section of a coil rotating in a magnetic field is shown. Here again, for the case of d-c excitation of the field, the voltage can be considered as induced either by the cutting of the magnetic lines by the two individual coil sides, or by the flux associated with the coil changing with the rotation of the coil. It was the cutting concept, however, that misled the young inventer mentioned in my earlier letter (*EE, Oct.' 45, p 381*) into believing that he could induce a direct voltage in the coil by exciting the field synchronously, that is, by seeing to it that when coil side *A* was coming around to the lower position, this pole had become a north pole. He overlooked the fact that at the instant when the coil is in a horizontal position, it forms a transformer with the a-c exciting winding of the main field; that at this instant the field passing through the coil changes and, therefore, produces a voltage, even if no lines are being cut at this instant. Mr. Hansen's explanation of the resulting double frequency by resolving the single-phase field into two oppositely rotating fields, is, of course, the simplest way; but,

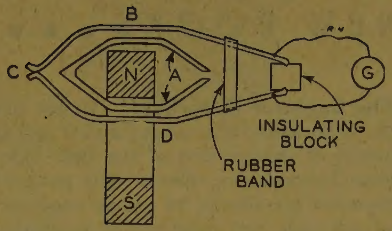


Figure 4

since this resolution is more or less a mathematical concept only, the explanation employing the "change of flux" seems to be a more fundamental one, even if it is not the simpler one.

But where does the rate-of-change-of-flux-linkage concept leave us in the case of the problem cited by Mr. Hansen? I am not ashamed to admit that, when this tricky arrangement was first shown to me a few years ago, my immediate reaction was that there would be a voltage induced while the loop is pulled off the magnet. More careful analysis led to the following steps: consider the circuit shown in Figure 3 as lying in the plane of the paper, while the two cross sectioned rectangles represent the two legs of a horseshoe magnet penetrating the paper, so that the flux of the magnet penetrates the loop *ABEF*. Now let the rotary switch be operated in the direction indicated; this enlarges the loop to *ABCDEF* without opening the circuit. There is no reason why a voltage should be induced during the switching operation. Now move the magnet horizontally to the dotted position. This movement does not change the flux linking with the loop *ABCDEF*, and, therefore, no voltage will be induced during the movement. Next, return the rotary switch to the position as shown. Again no voltage will be induced, because, while it may seem that the flux has disappeared out of the original loop, we have accomplished it by transferring it to another section and then pinching off this section; in other words, we were not always dealing with the same loop.

Now consider Figure 4, which is essentially the same as that shown by Mr. Hansen, except that the copper strip *A* has been placed around the leg of the magnet. The flux of the magnet passes through the loop *BCD* in the position shown. When we now move this loop to the right, it will spread open at *C* and slide over strip *A*. During the sliding the flux penetrating the complete loop, which now consists of two parts, does not change. Finally, the loop *BCD* can be pulled clear of *A*, with zero flux through it. While a closed circuit has been maintained at all times, nevertheless, the flux passing through a loop containing the instrument never was changing at any time, it was taken out of the original loop by pinching of part of the final loop.

These two examples show that a magnetic flux may be taken out of a loop without inducing a voltage, if commutation is resorted to. This is obviously the case when the clip is slipped over the leg of the magnet itself, where a continuous commutation takes place during the sliding of the clip.

WALTHER RICHTER (F '42)

(Electrical engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.)

To the Editor:

In commenting on Mr. Richter's letter in the October 1945 issue of *Electrical Engineering*, I had no intention of becoming a participant in a controversy over concepts of electromagnetic induction. I am quite neutral in the matter and merely wished to call attention to a forceful argument presented many years ago against the unqualified acceptance of the "change of flux" theory.

The fundamental requirement for induction of an electromotive force is that the conductor and the flux be in relative motion at right angles to one another. Whether the motion is looked upon as the flux being cut by the conductor, or as increasing or decreasing within a closed loop, seems to me to be immaterial.

Mr. Richter concedes that flux can be made to enter or leave a closed loop without inducing a voltage when commutation is resorted to. That is, of course, when cutting of flux is avoided. Commutation usually consists of transfer of current from one part of an electric circuit to another by means of a sliding contact. It is interesting to observe that when such contacts are employed the reverse of that phenomenon also can take place, namely, the induction of a voltage without flux increasing or decreasing within a closed loop.

In Figure 1 the solid metal disk, a portion of the shaft, the brush bearing on the shaft, the circuit containing the ammeter, and the brush bearing on the periphery of the disk constitute a closed loop. When the disk is rotated, a voltage is generated as shown by the ammeter.

The voltage generated is direct current and, when the direction of rotation is reversed, the polarity of the generated voltage is reversed. On the basis of the "change of flux" theory that means that the flux in the loop must be continually increasing in one case and continually decreasing in the other. Obviously such is not the case.

I believe it is even more difficult to account for this phenomenon on the basis of the "change of flux" theory without re-

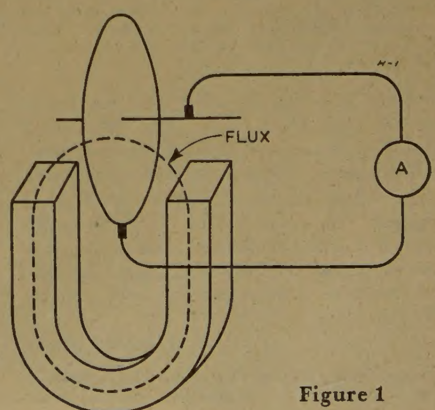


Figure 1

sorting to a far-fetched explanation than it is to explain transformer action between two stationary coils by the "cutting of flux" theory.

K. L. HANSEN (F'34)

(Consulting electrical engineer, Milwaukee, Wis.)

Atmosphere Penetration by Electromagnetic Waves

To the Editor:

In reading the most excellent March issue of *Electrical Engineering* I came across the news item, "Message to Moon Proves Atmosphere Penetration," on page 140. It contains the statement:

The principal significance of the radar-to-the-moon tests recently conducted by the United States Army Signal Corps, according to Major General Harry C. Ingles, Chief Signal Officer of the Army, is that they demonstrated for the first time that radio waves in the very high frequency band will penetrate completely the ionosphere, the celestial void, and whatever form of atmosphere may surround the moon.

Aside from the fact that electromagnetic waves, called light, have been penetrating the "celestial void" for eons, I wonder if the discovery of Karl G. Jansky in 1932 that radio waves of short wave length were coming to the earth from the Milky Way, which is a little farther than the moon, did not also prove that high frequency radio waves penetrate the ionosphere, the celestial void, and the atmosphere of the earth?

Karl Jansky's discovery was published in the October 1933 *Proceedings* of the Institute of Radio Engineers, pages 1387–98, under the title, "Electrical Disturbances Apparently of Extraterrestrial Origin." The following is quoted from that paper:

Electromagnetic waves of an unknown origin were detected during a series of experiments on atmospherics at high frequencies. Directional records have been taken of these waves for a period of over a year. The data obtained from these records show that the horizontal component of the direction of arrival changes approximately 362 degrees in about 24 hours in a manner that is accounted for by the daily rotation of the earth. Furthermore the time at which these waves are at a maximum and the direction from which they come at that time changes gradually throughout the year in a way that is accounted for by the rotation of the earth about the sun. These facts lead to the conclusion that the direction of arrival of these waves is fixed in space; that is, that the waves come from some source outside the solar system. Although the right ascension of this source can be determined from the data with considerable accuracy, the error not being greater than ±7.5 degrees, the limitations of the apparatus and the errors that might be caused by the ionized layers of the earth's atmosphere and by the attenuation of the waves in passing over the surface of the earth are such that the declination of the source can be determined only approximately. Thus the value obtained might be in error by as much as ±30 degrees.

Mention of the discovery also was made in the *New York Times*, the *New York Herald Tribune*, the *Chicago Tribune*, and other papers. Doctor Stetson discusses it in his book, "Earth, Radio and the Stars," chapter 16, page 233. The *Scientific Journal* of Bell Telephone Laboratories contained papers on the subject, and the discovery once was broadcast over station WEAF.

C. M. JANSKY (F'32)

(Professor emeritus of electrical engineering, University of Wisconsin, Madison, Wis.)

NEW BOOKS • • •

"The Engineer in Society." Under this title, John Mills, who retired a year ago as director of publications of the Bell Telephone Laboratories, directs some pungent comments specifically to young engineers and scientists and incidentally to anyone else who happens to get in the way. Reflecting his 45 years of personal experience in dealing with things and with people, he believes that "Engineers as a class are too modest. Even as individuals, they are rarely boastful of their ability or their accomplishments. They do not advertise themselves or their profession. It should not have required the development of an atomic bomb to direct attention to the political importance of science and engineering. Nor to emphasize for scientists and engineers their relationship to the world society of which they are a part. These recognitions are by-products which may prove to be more influential than the bomb itself. The immediate problem before engineers and scientists in industry is an engineering study of their class relationship to society." In spite of the fact that popular lists of "Noteworthy persons" traditionally list monarchs, warriors, artists, actors, and writers, while engineers remain largely in anonymity, Mr. Mills thinks that the engineering profession is not in the doldrums, but "is near the top and with potentiality yet unrealized, which can and should be released by the coming generation." Based upon his long and intimate experience with industrial scientists, Mr. Mills advances characteristically challenging ideas about aptitude tests and the business of fitting the right man to the right job; about "scientists gone executive," and the salaries of engineers and scientists; about woman's part in engineering work; about the question of an over-all organization of scientists and engineers. He undertakes to reveal certain of the road blocks that must be passed before engineers and scientists find their most serviceable and mutually satisfactory position in society. By John Mills. D. Van Nostrand, New York, N. Y. 1946. 196 pages, $7^1/_2$ by $8^1/_4$ inches, cloth, $2.50.

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

RAILROAD AVENUE. By F. H. Hubbard. McGraw-Hill Book Company, Inc., Whittlesey House Division, New York, N. Y., and London, England, 1945. 374 pages, illustrated, 9 by 6 inches, cloth, $3.75. The author of this book on railroading and railroaders has collected his material with an eye for the entertaining. Among the stories and legends are authoritative versions of old favorites, as well as a variety of lesser-known and obscure items from the full history of the period. Songs and poems from and about railroad life are reproduced, and there is a vocabulary of "railroad lingo." The book is well illustrated by contemporary portraits, drawings, and photographs.

BASIC ELECTRICAL ENGINEERING, Circuits, Machines, Electronics. By A. E. Fitzgerald. First edition, McGraw-Hill Book Company, New York, N. Y., and London, England, 1945. 443 pages, illustrated, diagrams, charts, tables, 9 by $5^3/_4$ inches, cloth, $3.75. This new textbook presents an integrated treatment of circuit theory, electric machinery fundamentals and applications, and engineering electronics together with discussion of instrumentation and of automatic-control applications in research and industry. It is intended for students who have had a course in college physics and have some experience in simple d-c theory.

TELEVISION SIMPLIFIED. By M. S. Kiver, D. Van Nostrand Company, New York, N. Y., 1946. 375 pages, illustrated, $8^1/_4$ by $5^1/_2$ inches, cloth, $4.75. A complete, practical description of modern television is presented in step-by-step fashion without involved theory or mathematics. The author proceeds from the analysis of circuits and the operating fundamentals of frequency modulation to the repairing of television sets and the explanation of an actual trouble-shooting system. The book is intended for radio workers, owners and service men, and all who are interested in television and its opportunities.

RADAR. By O. E. Dunlap, Jr. Harper and Brothers, New York, N. Y., and London, England, 1946. 208 pages, illustrated, $8^1/_4$ by $5^1/_4$ inches, cloth, $2.50. Written for the layman, this book traces the history of radar from the early reflected wave experiments of Hertz and Marconi and presents a simple explanation of its basic features. The range and likely worth of various peacetime applications are considered, and a glossary and bibliography are appended.

PAMPHLETS • • •

The following recently issued pamphlets may be of interest to readers of "Electrical Engineering." All inquiries should be addressed to the issuers.

Report PB-15058. A description of experiments in diversity reception. Office of the Publication Board, Department of Commerce, Washington 25, D. C. Photostat copy, $3; microfilm copy, 50 cents.

Report PB-15055. Data on European radio tubes, military and commercial. Office of the Publication Board, Department of Commerce, Washington 25, D. C. Photostat copy, $5; microfilm copy, $1.

Weston Engineering Notes. Bimonthly publication. Anyone whose interests include instrumentation problems may be placed on the mailing list. Address John Parker, editor, Weston Electrical Instrument Corporation, Newark 5, N. J.

A Guide to the Literature on the History of Engineering Available in the Cooper Union Library. Bulletin 28. This bulletin is an inventory of books and articles in the library which are likely to be of interest to the student of the history of science and engineering. In addition it is hoped that it may prove of value to the engineering librarians of other colleges as a check list to help present the historical material of their libraries. The Librarian, Cooper Union Library, Cooper Square, New York 3, N. Y., 46 pages.

Philips Research Reports. A bimonthly journal edited by N. V. Philips Gloeilampenfabrieken of Eindhoven, Holland. Subscriptions are handled in the United States by Elsevier Publishing Company, Inc., 215 Fourth Avenue, New York, N. Y. Yearly subscription $5.